OCTOBER, 1959
No. 241

ASTM Bulletin

To Be Published by ASTM, 1959–1960 . . . 5
Research for Better Roads 14
A Plea for Plain Talk 18

American Society for Testing Materials

RESEARCH AND STANDARDS FOR MATERIALS

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ASTM BULLETIN

October 1959 **Number 241**

Telephone: LOcust 3-5315 **Cable Address: Testing, Philadelphia**

TECHNICAL PAPERS

An In-Place Strength Test for Low-Density Concrete—Irwin A. Benjamin and George D. Ratliff, Jr. *Nondestructive penetration test shows good correlation with compressive-strength test results from cubes* 23

The Effect of Brick Facial Texture Upon the Initial Rate of Absorption—P. T. Hodgins. *Researchers in brick masonry are cautioned about the pickup of capillary moisture by specially textured ends and faces of some bricks* 27

Thermal Insulation Measurements on Textiles—A Comparison of Two Methods—Paul Wing and C. J. Monego. *Data obtained with the Guarded Ring Hot Plate and with the Cenco-Fitch apparatus are compared* 29

A Powder Explosibility Tester with Continuous Feed—W. D. Box. *With this system, the limits of concentration of powder in air within which explosions occur can be found by continuously varying the powder-to-air ratio until the mixture ignites* 34

Discussion of a Paper on Effect of Specimen Taper on Determination of Elongation in the Tension Test—F. H. Dill 37

High-Stress, Low-Cycle Fatigue Properties of Notched Alloy Steel Specimens—S. Yukawa and J. G. McMullin. *Three types of specimens were tested at nominal stresses of 50 per cent or more of their static strength* 38

Discussion of a Paper on a Modified Vicat Type Apparatus for Measuring the Softening Point of Thermosetting Plastics and Laminates—N. R. Miller 40

The Use of Molded Activated Carbon Getters in Sealed Electrical Instruments—*Technical Note* by J. R. Laskie 41

New Concrete Joint Sealant Testing Machine—R. J. Schutz and A. Van Hauter. *Research tool will add to our knowledge of the properties of joint sealing materials and the mechanics of joint design* 42

Specimen Deflection Determination from Crosshead Travel in Three-Point Flexure Tests—C. D. Doyle and W. V. Olszewski. *Useful procedure when testing large number of specimens at temperatures above or below room temperature* 44

RESEARCH AND STANDARDS IN ACTION

To Be Published by ASTM in 1959–1960 5

Headquarters Research File 12

Research Today for Better Roads Tomorrow—Ellis L. Armstrong 14

A Pig Is a Pig Is a Pig—A. Q. Mowbray 18

ASTM Standards at Work 21

DEPARTMENTS

ACR Notes	21	Material Questions	13
Actions on Standards	22	New Members	64
Bookshelf	52	News of Members	68
Coming Technical Papers	12	Other Societies' Events	62
Deaths	72	OTS Reports	62
District Activities	20	Random Samples	47
Editorial	12	Schedule of ASTM Meetings	13
Government Standards Changes	78	Technical Committee Notes	20
Index to Advertisers	79	Your Committee Officers	17
Laboratory Supplies & Equipment	76		

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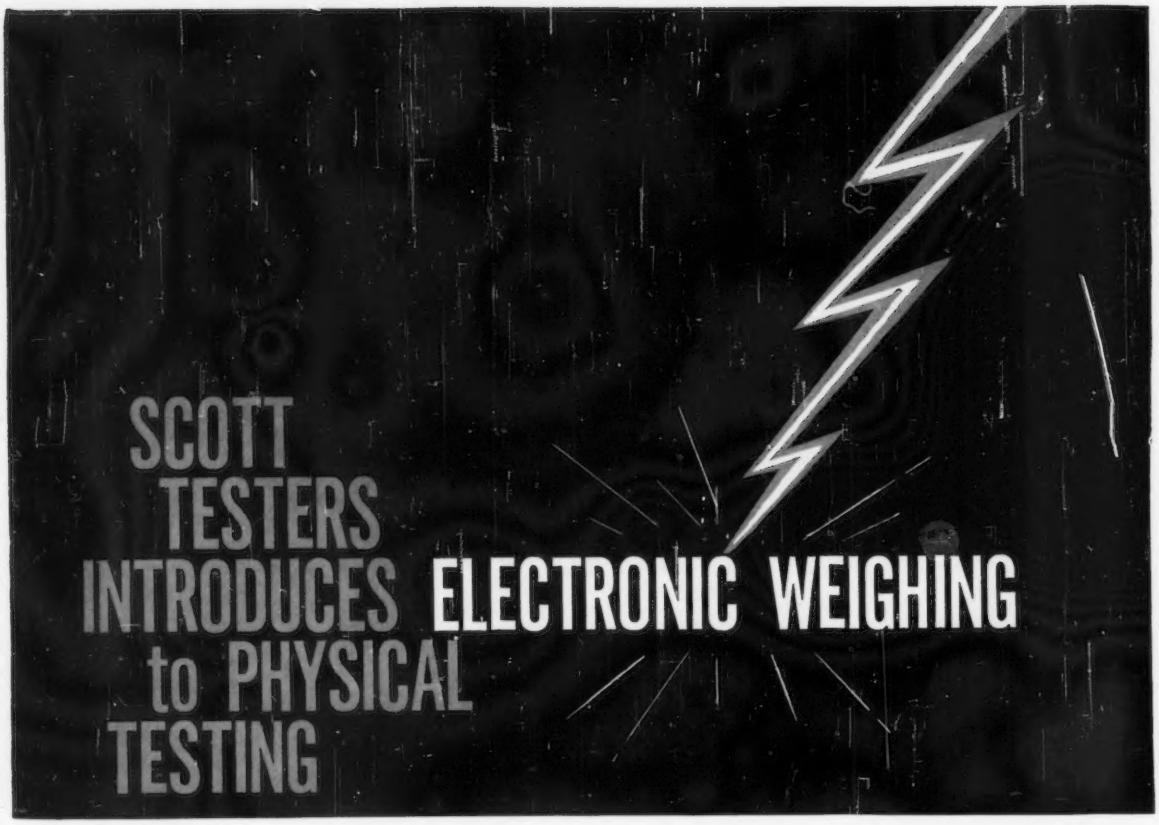

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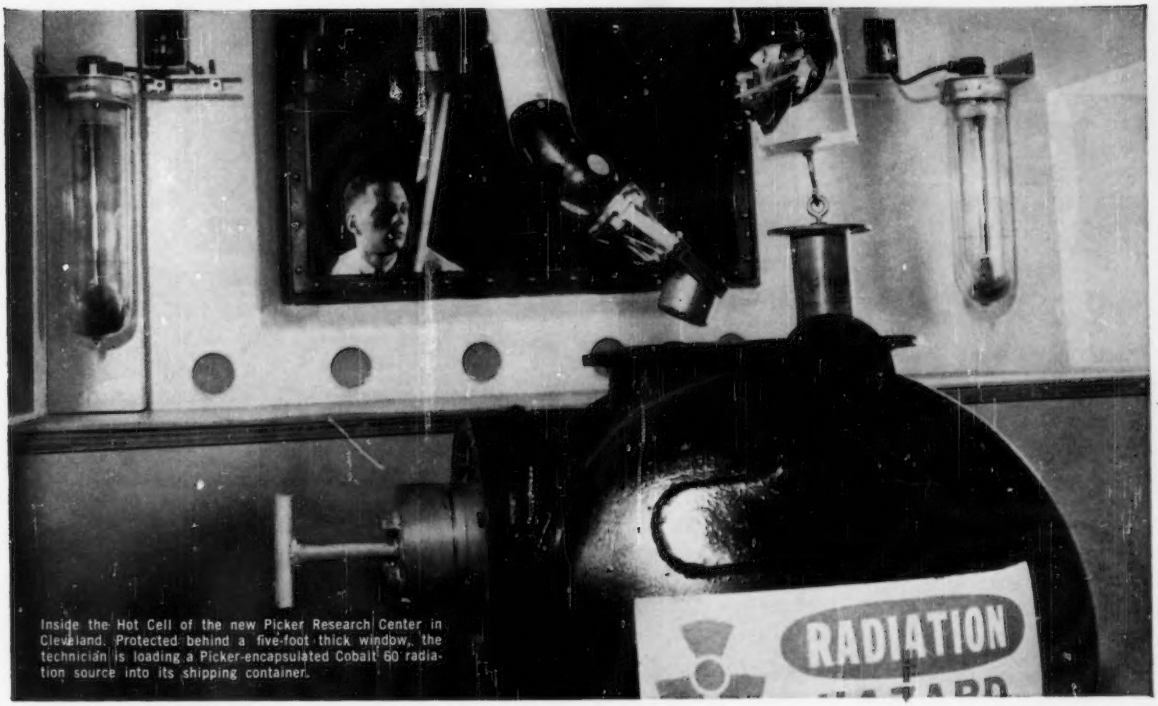

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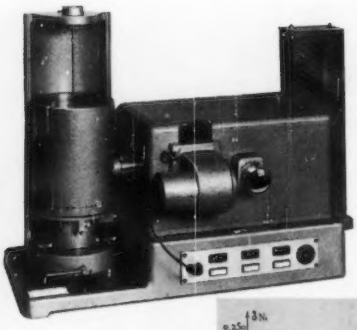
- Dry oxidation of metals and alloys
- Solid system changes accompanied by addition or loss of gas or vapor
- Dissociation of true chemical compounds formed when a gas is absorbed by a solid
- Thermal data on the calcination of precipitates
- Drying products in powder form

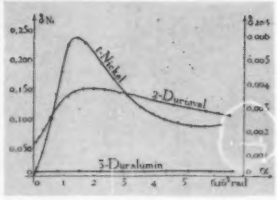
MI-9 MICROPENDULUM "COULOMB"

Specially designed for a specific field of testing, the MI-9, through attenuated oscillations, determines:

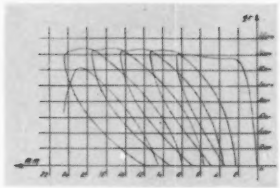
- The variations of internal friction in metals
- Magneto-elastic anomalities of metals and ferromagnetic alloys
- Changes of internal friction due to cold working
- The mechanical hysteresis and fatigue of metals.



MI-9

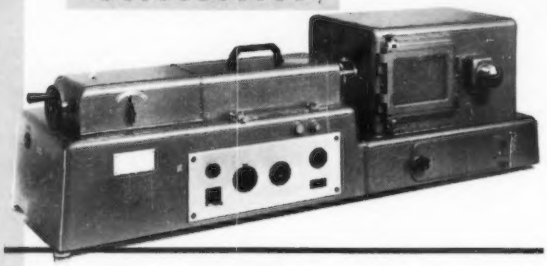


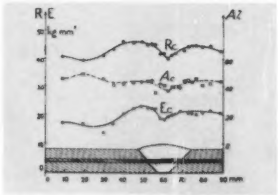
Curves plotted by evaluating the damping diagrams. On the Nickel and Durinval curves the magneto-elastic anomalities inherent to ferromagnetic materials is clearly defined.
The very slight decrement of Duralumin is so-to-say independent of the amplitude.



MI-44

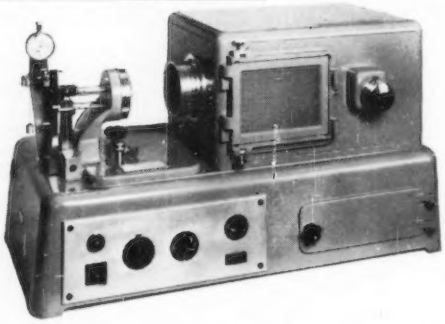
Load-deformation curves of flat, colorless extruded polyethelyne, employing a 3 kg. maximum capacity dynamometer.





MI-34

Detailed investigation of a weld made by carrying out Micro Shearing tests. A Chromium-Molybdenum steel welded with an electrode of the same material.



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ASTM BULLETIN

Research and Standards for Materials

Number 241 October 1959

To Be Published by ASTM in 1959–1960 . . .

The ASTM publications that will appear within the next 12 months are the end product of the Society's recent activities. The volume of publications, which continues to grow from year to year, will be swelled this year by more than 225 papers presented at the Third Pacific Area National Meeting being held this month. The following pages give a quick preview of the coming year's publications as they are now planned.

The special technical publications (STP's), which contain, for the most part, symposia papers, contribute greatly to that phase of the Society's work concerned with the promotion of the knowledge of materials. The 1959 Supplements to the Book of Standards and the numerous special compilations of related standards reflect the growing effort in the Society's second field—standardization of specifications and test methods.

Members will be advised of the appearance of these publications; as they become available, notices will appear in the BULLETIN. Most of the publications will bear special prices for members. A few of the publications in the following list are available now.

Regular Publications

1959 Supplements to the 1958 Book of Standards

The three-year cycle of the Book of Standards marks 1959 and 1960 as Supplement years. The 1959 Supplements to the 1958 Book of Standards will be issued in ten parts in heavy paper covers. Their 3000 pages will include the new and revised standards and tentatives adopted or accepted at the 62nd Annual Meeting or by the Administrative Committee on Standards. The ten parts are:

Part 1—Ferrous Metals (Specifications)
Part 2—Non-Ferrous Metals (Specifications), Electronic Materials
Part 3—Methods of Testing Metals (Except Chemical Analysis)
Part 4—Cement, Concrete, Mortars, Road Materials, Waterproofing, Soils
Part 5—Masonry Products, Ceramics, Thermal Insulation, Acoustical Materials, Sandwich and Building Constructions, Fire Tests
Part 6—Wood, Paper, Adhesives, Shipping Containers, Cellulose, Leather
Part 7—Petroleum Products, Lubricants, Tank Measurements, Engine Tests
Part 8—Paint, Naval Stores, Aromatic Hydrocarbons, Coal and Coke, Gaseous Fuels, Engine Antifreezes
Part 9—Plastics, Electrical Insulation, Rubber, Carbon Black
Part 10—Textiles, Soap, Water, Atmospheric Analysis, Wax Polishes

The parts shown in boldface type (parts 2, 8, and 10) are now available. All parts should be available by the end of the year.

Compilations of Standards

So many factors affect the release of the compilations that it is not possible at this time to give an accurate estimate of their size or the date they will become available. The size is affected by committee recommendations which may be submitted through the Administrative Committee on Standards, and the date of issue is governed somewhat by editorial considerations and the relation of these special compilations to the appearance of the various parts of the Supplements to the Book of Standards. The tabulation given below is, therefore, approximate.

STANDARDS COMPILATION SCHEDULE

Sponsoring Committee	Title	Approximate Number of Pages	Approximate Appearance Date
A-1, A-5[a]	Steel Sheet and Strip	148	September
A-5	Corrosion of Iron and Steel	170	January
B-1	Metallic Electric Conductors	344	January
B-5	Copper and Copper Alloys	720	November
B-7	Light Metals and Alloys	360	November
B-9[a]	Metal Powders and Metal Powder Products	130	October
D-2[a]	Petroleum Products and Lubricants	1240	October
D-5[a,b]	Coal and Coke	144	September
D-9	Electrical Insulating Materials	750	November
D-11	Rubber and Rubber-Like Materials	960	December
D-13	Textile Materials	930	November
D-19	Industrial Water	660	November
D-20	Plastics	1250	December
D-22	Atmospheric Sampling and Analysis	80	November
	Supplement to Building Code Compilation	230	January

[a] Available now.
[b] Announced in Sept. BULLETIN

To Be Published by ASTM . . .

Metal Powders

Compilation of Standards, B-9 (Available Now)

This first edition of "ASTM Standards on Metal Powders and Metal Powder Products" provides a valuable compilation of standards developed by ASTM Committee B-9 on Metal Powders and Metal Powder Products since its organization in 1944. The 23 standards in the book cover metal powders, bearings, structural parts, carbides, heavy metals, and terminology relating to powder metallurgy.

In addition, a general description of production processes, mechanical properties, and uses of metal-powder sintered bearings and structural parts is appended. This information provides an important preface to a group of specifications covering structural parts. A second appendix provides a cross index to the standards of other organizations, such as the Metal Powder Industries Federation (MPI), Society of Automotive Engineering (SAE). and federal agencies, civilian and military.

The table of contents refers to other ASTM test methods, not included in the compilation, that can be used for determining mechanical and physical properties not specifically defined in the B-9 methods.

ASTM Standards on Metal Powders and Metal Powder Products, 96 pages, hard cover, price $2.25, to members $1.80.

Petroleum Products and Lubricants

Compilation of Standards, D-2 (Available Now)

The 1959 edition of the ASTM Compilation of Standards on Petroleum Products and Lubricants contains almost 200 standards, of which some 45 are new, revised, or changed in status. The standards have been prepared by ASTM Committee D-2 on Petroleum Products and Lubricants. A number of test methods proposed but not yet adopted by the committee are included as appendices.

This comprehensive book contains standards on crude petroleum, butadiene, motor and aviation fuels, naphthas, diesel fuels, lubricating oils, industrial oils, cutting oils, turbine oils, greases, waxes, spray oils, and other related materials.

Petroleum chemists and technologists, engineers, and purchasing agents will find this compact volume handy in their daily work.

ASTM Standards on Petroleum Products and Lubricants, 1232 pages, hard cover, price $9.00, to members $7.20.

1959 *Proceedings*

The 1959 *Proceedings* will contain about 1400 pages of technical papers and discussion presented at the 1959 Annual Meeting. All reports submitted by the Society's technical committees at the Annual Meeting are also included.

The Gillett and Marburg Lectures are issued as separate publications and no longer appear in the *Proceedings*. Copies, however, are available without charge to members on request.

Following the usual practice, the papers and discussion presented at the Annual Meeting in special symposia will appear in special technical publications.

Year Book

The Year Book contains a list of the complete membership, and official company-member representatives (name, title, address, company). Starting with 1959, lists of subcommittees and their officers will be published each year, but complete lists of subcommittee personnel will be published only in the even-numbered years. The personnel of the main committees will be listed each year. The geographical listing of the membership will be given in the odd-numbered years but omitted in the even-numbered years. The Year Book also contains other useful information about the Society. It is furnished to members without charge, on request, and may be purchased by committee members. Members who wish to have a list of subcommittee personnel should hold their 1958 Year Books until the 1960 Year Book is issued.

1959 Index to ASTM Standards

As the number of published ASTM standards grows, this Index increases in value. Providing the latest complete reference to the publications in which the various specifications and test methods appear, it is particularly useful during the years in which the Supplements to the Book of Standards are issued. Publication of the new Index is scheduled for February.

1959 Marburg Lecture* *New Polymers—New Problems*

By Herman F. Mark

The Edgar Marburg Lecture was established as a memorial to the first secretary of the Society, to emphasize the importance of adding to our knowledge of properties and tests of engineering materials. At the 1959 Annual Meeting, the 33rd Edgar Marburg Lecture, entitled *New Polymers—New Prob'ems*, was presented by Herman F. Mark, director, Polymer Research Inst., Polytechnic Institute of Brooklyn.

Dr. Mark discusses the new catalytic systems that have been discovered during the past few years and new methods of polymerization which permit the preparation of many organic polymers with a much higher degree of molecular regularity than was possible before. Some of these new materials have already found interesting and meaningful applications. Others are just now being investigated for profitable and promising uses. But besides their practical applicability, these highly ordered macromolecules have also posed new fundamental questions of nomenclature, classification, and characterization. They force us to widen our scope and to expand the basic framework of polymer science so that we can adequately describe and interpret all the data assembled within the past few years.

1959 Gillett Lecture* *The Role of Dislocations in Plastic Deformation (of Metals)*

(Available Now)

By John C. Fisher

The eighth Gillett Memorial Lecture, *The Role of Dislocation in Plastic Deformation (of Metals)*, was presented by John C. Fisher, physicist, General Electric Co. This lecture, jointly sponsored by ASTM and the Battelle Memorial Institute, commemorates Horace W. Gillett, the first director of Battelle and one of this country's leading metallurgists.

It is now known that metals and other crystalline materials deform plastically through the movement of dislocations. These imperfections, which are wrinkles in the atomic layers of a crystal, have been observed by a number of experimental techniques, and their motion has been followed during the

* Presented at the 1959 Annual Meeting in Atlantic City, N. J., June 21–26.

course of plastic deformation. High strengths can be achieved by eliminating dislocations entirely, or by the more common method of blocking their movement. At present the dislocation concept makes it possible to account, semiquantitatively, for the strength of alloys.

Special Publications

Metals

Report on Stress-Corrosion Cracking of Austenitic Chromium-Nickel Stainless Steels (STP 264)

Sponsored Jointly by ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, and NACE Committee T-5E on Stress Corrosion Cracking of Austenitic Stainless Steel.

These two committees have collected, organized, and tabulated 145 case histories of stress-corrosion cracking in austenitic stainless steels. Each case history describes the process, time for cracking to develop, location and identification of cracks, the materials involved, the corrosion media, etc. These case histories are reviewed and discussed by scientists in this field. The present status of research and knowledge on the basic mechanism of stress-corrosion cracking is also presented.

Symposium on Electroless Nickel Plating (Catalytic Deposits of Nickel-Phosphorus Alloys by Chemical Reduction in Aqueous Solution) (STP 265)

Sponsored by Committee B-8 on Electrodeposited Metallic Coatings

(Available Now)

This symposium is a definitive survey of the present status of this new technology. Recognized authorities in this new field have prepared detailed discussions that cover the following subjects: The history of the electroless plating process, the basic reactions, the characteristics of electroless deposits, the processing procedures, the advantages and limitations of this process, applications, test methods for these deposits, abstracts of patents issued, and an extensive bibliography.

The purpose of presenting this symposium is to acquaint those unfamiliar with this technique with the advantages and problems encountered in this fruitful field.

STP 265, size and price to be announced.

INERT GAS ATMOSPHERE WELDING

Titanium valve components are welded inside a plastic bag filled with inert gas. Eleventh ASTM photograph exhibit. William W. C. Wilke, Jr., Crane Co., Chicago, Ill.

*Symposium on Electron Metallography (STP 262)**

Sponsored by Committee E-4 on Metallography

Papers on this subject have been published by the Society as a result of the Annual Meeting sessions sponsored by Committee E-4. As in 1958 (STP 245), the papers presented will be published as a Special Technical Publication. The 1959 volume will include papers on the electron metallography of various steels (including the structural effects of neutron irradiation), of tin oxides and tin plate alloy layers, of dislocations, and of high-temperature alloys. Other papers discuss electron diffraction techniques and electron microprobe measurements. The subject of phase morphology in high-temperature alloys has again been given special attention. The papers on this topic include the Seventh Progress Report by Subcommittee XI of Committee E-4, *Electron Microstructure of Precipitation-Hardenable Austenitic and Nickel-Base Alloys.*

There has been widespread interest in the subjects discussed. From these E-4 sponsored sessions and publications often come the sparks that ignite new committee activities to develop or standardize techniques promising important and broad metallurgical usage.

1958 References on Fatigue (STP 9-J)

Sponsored by Committee E-9 on Fatigue

This is a list of references to articles published in 1958 dealing with fatigue of structures and materials, following the plan used in previous annual lists from 1950 through 1957. References are generally so arranged that sheets can be cut apart for filing according to any desired plan. Brief abstracts have been included when these were available.

Elevated Temperature Properties of Aluminum and Magnesium Alloys

Sponsored by ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals

This is another in the series of reports on the elevated temperature properties of various metallic materials prepared under the auspices of the Data and Publications Panel of the Joint Committee. It includes data for tensile, yield, elongation, reduction of area, creep, and rupture properties of aluminum and magnesium wrought and cast alloys.

The collection of data for these alloys resulted in a voluminous accumulation of information which, if used in its entirety, would necessitate printing a number of volumes. Faced with the problem of streamlining this presentation, the committee reduced the number of heat treatments to a minimum, and limited the data to materials of commercial interest. The resulting data are arranged in the form of graphs and data sheets for convenient use.

Literature Survey on Creep Behavior (STP 260)

Sponsored by ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals

To determine the state of knowledge in the field of creep damage, the Joint Committee sponsored a two-part project designed to survey the published literature relating to cyclic loading and the influence of stress concentrations at elevated temperatures. The result is this publication which brings into focus in a comprehensive fashion the tremendous amount of information available on these subjects.

The survey covering the effects of nonsteady load and temperature conditions on creep of metals describes the fundamental investigations, summarizes data on alloys under complex variations of load and temperature, and reviews several analytical procedures for calculating nonsteady behavior from steady-state stress tests.

To Be Published by ASTM . . .

The survey on stress concentrations reviews the available notch-rupture data with the idea of establishing fundamental influences of stress concentrations, testing variables, and the influence of alloy compositions. Also included is a section dealing with the application of notch data to the problem of component design.

Extensive use has been made of graphs for presentation of data. Complete bibliographies are also included.

Construction Materials

Bituminous Materials (STP 252) (Symposium on Method of Test for Design of Bituminous Paving Mixtures, Symposium on Practical and Statistical Significance of Tests and Properties of Bituminous Binders)*

Sponsored by Committee D-4 on Road and Paving Materials

Symposium on Method of Test for Design of Bituminous Paving Mixtures

The papers in this symposium present information on results of tests conducted primarily to determine stability. Other factors such as density, durability, flexibility, resistance to skidding, and workability during construction operations are also covered to some extent. The papers pertain primarily to bituminous paving mixtures for highways and streets, but some of the information is applicable to airport pavements.

During 1958, Committee D-4 adopted tentative standards for the Marshall stability test and the Hveem stabilometer and cohesiometer tests including the California kneading compactor. Also, an extensive revision of the compressive strength test was completed. In view of these developments and the current interest in design of bituminous paving mixtures, this symposium was held. The eight papers comprising the symposium describe new developments and present new data obtained by using the standard methods of test with application to the design of bituminous paving mixtures.

Symposium on Practical and Statistical Significance of Tests and Properties of Bituminous Binders

The role of statistics in the testing and research of bituminous materials, particularly as used in highway construction, has not been sufficiently emphasized. With the great national expansion in highway and airfield construction, the amount of testing and research has increased accordingly. Committee D-4 felt that the statistical significance should be brought to the fore and sponsored this symposium for that purpose. This symposium reviews the historical background of the more widely used ASTM tests on paving materials, with particular reference to the role of the Society in their development and standardization; discusses the practical significance of certain key tests on paving cements; reviews the present status of the precision of test methods under the jurisdiction of Committee D-4; and describes a modern experiment design involving an ASTM test on bituminous material.

The four symposium papers do not attempt to solve any specific problems; rather they define what is believed to be a fairly general problem in the field of testing of bituminous materials, place it in perspective, and point out several possible directions for a solution.

Also included in this symposium volume are the two papers presented at a general Annual Meeting session on road and paving materials which cover the use of capillary viscometers and fundamental viscosity units as a substitute for the Saybolt Furol viscometer for practical refinery control of cutback asphalt production and density changes in asphalt pavement core samples.

Soils (STP 254) (Symposium on Time Rate of Loading in Soil Testing, Symposium on Atterberg Limits, General Papers and Discussion)*

Sponsored by Committee D-18 on Soils for Engineering Purposes

Symposium on Time Rates of Loading in Soil Testing

This symposium delineates the scope and nature of the influence of time rates of loading on results of soil tests, describes the uses to be made of soil test data, collects the body of present knowledge on this subject, presents the best of laboratory and field experience with testing procedures, and formulates present ideas and concepts into a set of basic and systematic conceptions and working principles. Soil, by the very nature of its character and responses, is probably the one engineering material most susceptible to and most influenced by time rates of loading. A primary objective in preparing soil-test procedures is to develop a system of simulated service tests which yield reliable results having significant and direct application to practical problems of design and construction.

Symposium on Atterberg Limits

The Atterberg Limits are perhaps the oldest and most widely accepted of all the engineering tests of cohesive soils. Unfortunately, the apparatus and methods employed by various organizations throughout the United States and other countries differ. This leads to much uncertainty in evaluating the test data properly. Some of the apparatus and procedures specified by ASTM are not entirely satisfactory because of their excessive dependence on operator skill, their nonsuitability for certain types of slightly cohesive soils, and their need for large amounts of time to obtain satisfactory results. This symposium presents data on the effects of different test procedures on the results, compares the results obtained by various short-cut procedures, and examines alternate test methods which do not have the limitations of the present ASTM procedures. This symposium will be a guide to the appropriate subcommittees in revising and strengthening the ASTM standards.

General Papers

Three papers covering laboratory and field tests of cement-treated, granular base-course materials; powder versus slurry application of lime for soil stabilization; and improved determination of preconsolidation pressure of a sensitive clay are also included in this symposium volume.

Electrical Materials

1958 Supplement to the Bibliography and Abstracts on Electrical Contacts (STP 56-M) (Available Now)

Sponsored by Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance and Electrical Contacts. Prepared by Erle I. Shobert, II

This is the sixth supplement to the 1952 edition. The list of 182 abstracts in this supplement represents a considerable amount of effort. There is certainly no sign that all of the problems have been solved, and this general level of activity is expected to continue. The publication of this supplement makes it possible for everyone concerned with electrical contacts to keep up to date with the latest information. The subject index lists the same headings as in previous editions: Electrical Contacts—General; Contact Materials—Fabricated; Contact Materials—Powdered Metals; Circuit Breaker De-

sign; Circuit Breaker Testing; Contactor or Relay Design; Stationary or Fixed Contacts; Sliding Contacts—Slip Rings; Sliding Contacts—Commutation; Miscellaneous Special Applications; Contact Resistance; Electric Arc Theory as Applied to Contacts; Electric Arc Theory; Glow Discharge Theory; Contact Wear; and Circuit and Circuit Parameters as Applied to Contact Operation.

STP 56-M 56 pages, heavy paper cover, price $2.50, to members $2.00.

Petroleum Products, Water

ASTM Manual for Rating Motor Fuels by Motor and Research Methods—1959

This manual has been prepared for two reasons: (1) to revise and bring up to date ASTM Standards D 357 and D 908 and to include the new standard D 1656, and (2) to better serve users of ASTM knock test engines by providing six appendices which present in a systematic way, by word and picture, factual information and data on the operation and maintenance of the knock testing equipment. Careful study and use of this manual should enable qualified personnel to install and operate knock testing equipment for the motor and research methods.

Titles of the three standards included are:

D 357 – 59, Knock Characteristics of Motor Fuels by the Motor Method

D 908 – 59, Knock Characteristics of Motor Fuels by the Research Method

D 1656 – 59 T, Knock Characteristics of Motor Fuels Above 100 Octane Number by the Research Method

The six appendices are titled: Apparatus, Reference Materials and Blending Accessories, Operation, Maintenance, Installation and Assembly, and Building and Utility Requirements.

*Symposium on Identification of Water-Formed Deposits (STP 256)**

Sponsored by Committee D-19 on Industrial Water

Since the most recent symposium on this subject in 1947, X-ray diffraction methods have been much improved by the use of the diffractometer, semiquantitative spectrographic methods have been developed and applied, and a number of newer analytical techniques have been brought to bear on the deposit problem. The present symposium describes the usefulness of these analytical tools in determining the nature of deposits, starting with a statement of the problem from the standpoint of the water-treatment engineer. Then follow methods of elemental analysis (excluding wet chemical), phase identification, the study of thin corrosion films on steel, and finally the correlation of elemental analysis with phase identification, using the techniques employed for many years by the mineralogist. The symposium was organized in a sequence which might be followed by one seeking as much information as possible concerning the nature of a deposit. This symposium volume comprises five papers plus a summary.

Manual on Industrial Water and Waste Water

Sponsored by Committee D-19 on Industrial Water

The influence of water on various industries ranges from that in paper manufacture, where enormous volumes are used and its quality is of great importance, to small industries where only incidental supplies are needed. At no level, however, can the amount and nature of the available water be disregarded lest a plague of supply failure, contamination, corrosion, scaling, or other difficulty arise to interfere with the manufacturer's operations and to sap his profits.

Executives, plant managers, designers, technologists, and administrators will find in this manual information on the influence of water on industries in which it is used either as a raw material or in conjunction with manufacturing processes. Combined with general discussion of the problems arising from industrial use of water are details of specific control procedures and instructions for such critical operations as sampling water under the various conditions and in the several forms in which it is employed.

Chemists and other technologists having special knowledge of water can use the manual as a reference for specific information unassembled elsewhere. Standard methods for sampling, analysis, reporting, and testing water, developed by ASTM Committee D-19 on Industrial Water, are included for ready reference, together with constants, names, and other factors of immediate usefulness to water practitioners. Techniques which have not yet been standardized are discussed to aid the water specialist in keeping abreast of new developments.

This edition of the manual represents a substantial expansion of the first edition. It has been designed to satisfy the growing need for dependable information about water and the problems its use entails.

STP 148-D, 660 pages (approx.), hard cover, price $11.00, to members $8.80.

THE TYNDALL EFFECT

Honorable mention, black and white— General. Eleventh ASTM photographic exhibit. Daniel R. Condon, United States Testing Co., Inc., Hoboken, N. J.

Plastics

International Symposium on Plastics Testing and Standardization (STP 247)

(Available Now)

This symposium presents four general topics. The first deals with "How National Standards Are Achieved." Twelve nations are represented in this section. The second part is "Engineering Properties of Plastics" containing six papers. "Thermal Properties of Plastics" with four papers forms the third part, and "Molecular Characterization" with four papers concludes the symposium.

Covering as it does such a wide area of activity, this extensive

symposium will be of keen interest to plastics engineers and technologists.

The symposium, sponsored by ASTM, in Philadelphia, was arranged to coordinate with the Eighth Annual Meeting of ISO Technical Committee 61—Plastics, which was held in November, 1958, in Washington.

The session on "How National Standards are Achieved" accomplished the very significant objective of presenting the 1958 national standardization story for each of twelve nations. This background will be most helpful in future work on plastics and, more broadly, in all international standardization. The sessions on engineering properties and on thermal properties of plastics dealt with techniques applicable to the standardization work of today and the future. The papers in these sessions were important not only for presenting information on the ever advancing technology, but for fostering understanding of the technical base on which the national standards of the world are built. Papers in the final session on methods for molecular characterization review the state of the art and point the way to standardization technology of the future. The contents include:

Introduction—George F. Hussey

Standardization in Belgium, Czechoslovakia, France, Germany, Hungary, Poland, Rumania, Sweden, The Netherlands, United Kingdom, USA, USSR

Summary—Robert J. Painter

Fundamentals of the Mechanical Properties of Plastics—B. Bossu, M. Chatain, P. Dubois and J. Rouqeaux (France)

Anisotropic Effects in Testing Plastics—Hilding Högberg (Sweden)

On the Most Suitable Specimen Shape for Testing Shear Strength of Plastics—Niuma Goldenberg, Mircea Arcan, and Edward Nicolau (Hungary)

Encyclopedia of Electrical Insulating Materials—G. de Senarclens (Switzerland)

Mechanical Properties of Plastics at High Speeds of Stressing—H. Warburton Hall (United Kingdom)

An Improved Flow Tester for Thermosetting and Thermoplastic Molding Compounds—C. M. von Meysenbug (Germany)

The Vicat Softening Point Test Method: Correlations, Uses, and Variants—C. E. Stephenson and A. H. Willbourn (United Kingdom)

Rheology of Polymer Melts—A Correlation of Dynamic and Steady Flow Measurements—W. P. Cox and E. H. Merz (USA)

Transition Phenomena in the Study of Impact Strength of Plastics—Michel Julliard (France)

The Accurate Determination of Molecular Weights of Macromolecules—Donald MacIntyre (USA)

The Use of Infrared Spectroscopy in Characterization of Polymer Structure—W. J. Potts (USA)

The Use of X-Ray Diffraction and Scattering in Characterization of Polymer Structure—W. O. Statton (USA)

Nuclear Resonance Studies of Polymer Chain Flexibility W. P. Slichter (USA)

STP *247*, 276 pages, hard cover, price $6.00, to members $4.80.

Chemical Analysis

*Symposium on Spectroscopic Excitation (STP 259)**

Sponsored by Committee E-2 on Emission Spectroscopy

Excitation is one of the most important variables in emission spectroscopic analysis. The matrix effect in excitation, the effects of gaseous atmospheres on excitation, and some properties of new or modified excitation sources are covered in this symposium. Extensive discussions of these papers adds greatly to their value.

While the effect of matrices on determinations of elements is well known, an unusually clear and complete discussion of this effect is given in the symposium paper on this subject. Equally comprehensive is the treatment of the effects of gaseous atmospheres on excitation. The paper on properties of excitation sources deals largely with sources that might permit greater precision and accuracy in the determination of major constituents, with considerable discussion of improved sources for use in flame photometry.

*Symposium on Radioisotopes in Metals Analysis and Testing (STP 261)**

Sponsored by Committee E-3 on Chemical Analysis of Metals

This symposium was organized to afford an opportunity to discuss different applications of radioisotopes to the metals industry. Radioisotopes do not hold the answer to all analysis problems; they, too, have their limitations. But in a number of areas they furnish unexcelled versatility and adaptability. The increasing use of analytical methods involving radioisotopes and the prospects for much greater use of such methods are dealt with in this symposium.

The principles, available techniques, capabilities, and problems involved in the use of radioisotopes in metals analysis and testing are covered in the introduction. The various types of instrumentation and techniques are described in one of the papers. A general coverage of metals analysis by radioactivation techniques is also included, and specific applications of radioactivation techniques is the subject of several of the papers. The importance of standard samples in activation techniques is brought out in these papers. Another paper describes referee analysis by means of isotope dilution methods. The practical problems of training industrial personnel in the use of radioisotopes is described in the last paper.

General

*Symposium on Microscopy (STP 257)**

Sponsored by Subcommittee 28 on Microscopy of Committee E-1 on Methods of Testing

Over the past 25 years, the development of new types as well as the greater sophistication of existing microscope designs has made it necessary to refine the techniques for using such equipment. Instrumental improvements have stimulated a corresponding interest in the refinement and re-evaluation of specimen preparation techniques. The advent of the electron microscope alone has spawned a whole host of methods to fit the very exacting requirements for this new tool. All too frequently the individual worker or group has had to improvise methods suitable for the problem at hand. This symposium, which comprises nine papers, brings together the many techniques and disciplines that are united by the use of a common instrument, the microscope, be it light or electron.

*Symposium on Visual Aids for Standardizing and Communicating Product Appearance (STP 258)**

Sponsored by Committee E-12 on Appearance

Some of the visual aids available for standardizing and communicating product appearance are discussed in this symposium. Admittedly, close specification and control of product appearance is desirable, but little attention has been paid to methods of achieving this. A survey of several interesting new developments is given, and the current status of product-appearance specification within ASTM is reviewed. The purpose of this symposium is to stimulate new and original thinking about the problems of product-appearance specification. The four papers in the symposium volume cover the status of ASTM methods and standards for appearance evaluation, visual aids in the textile industry, the potential uses of closed-circuit television for product inspection, and the use of color photography for product specification and control.

*Symposium on Education in Materials (STP 263)**

Sponsored jointly by the American Society for Engineering Education (ASEE) and ASTM

Probably no facet of engineering education merits more discussion today then education in materials. This symposium brings together the viewpoints of responsible men in the field of engineering education and representatives of industry. As pointed out in the introduction by Prof. K. B. Woods of Purdue University, developments in technology are occurring at a rate unmatched in the history of the world. These developments provide new tools in such fields as agriculture, engineering, and medicine. Corresponding changes are taking place in communications, transportation, and in such areas as rockets and missiles. All of this is common knowledge. What is not so well known and, in fact, not even well understood is the impact of these great achievements and advancements of science on education, not only on college and university curricula but also on high schools, elementary schools, and the technical institutes. The impact of science on engineering education has been especially profound in the field of engineering materials.

In addition to the introduction by Professor Woods, this symposium volume includes seven papers, a general discussion, and a luncheon talk, *Education in Engineering*, presented by Eric A. Walker, president of Pennsylvania State University.

West Coast Meeting Publications

The Third Pacific Area National Meeting held in San Francisco the week of October 11 was, in number of sessions, the largest national meeting ever sponsored by the Society. Many special technical publications will result from the symposia held at this meeting, and some papers may appear in the BULLETIN. Future issues of the BULLETIN will provide definite publication plans regarding these papers. West Coast Meeting sessions and symposia, from which these publications will result are:

Bituminous Waterproofing and Roofing Materials
Road and Paving Materials
Soils for Engineering Purposes
Effect of Water-Reducing and Set-Retarding Admixtures on Properties of Concrete
Masonry Materials
Methods for Testing Building Constructions
Wood in Building Construction
Treated Wood for Marine Use
Paint
Fatigue of Aircraft Structures
Durability and Weathering of Structural Sandwich Constructions
Technical Development in the Handling and Utilization of Water and Industrial Waste Water
Air Pollution Control
Newer Metals
Standards—Are Changes in Order?
Hydraulic Fluids
Electrical Insulation Materials
Adhesion and Adhesives
Reinforced Plastics
Thermal Ablation of Plastics
Post-Irradiation Effects in Polymers
Applied Radiation and Radioisotope Test Methods
Radiation Effects and Dosimetry
Ceramics in Nuclear Energy
Nondestructive Testing in the Missile Industry
Spectroscopy

Color Stability Data Needed

Color is one of the most striking, yet one of the most elusive of all the attributes of a physical object. To help in measuring it, there is a growing need for stable, rugged material standards, readily available in a wide range of colors. Late in 1957, the Inter-Society Color Council began a study to find out how best to fill this need. At the outset, ISCC gave as its objectives:

1. To determine what types of materials are most suited for use as colorimetric standards,
2. To develop specifications for preparing representative standards,
3. To arrange for the preparation, calibration, and distribution of the standards, and
4. To develop and recommend procedures for their care and use.

The Council soon found that little data existed to help with step 1. On the most important color attribute, stability, there was little information. It was therefore decided to enlist the volunteer aid of ISCC membership in a continuing program of measuring color stability of candidate materials. The Council has therefore issued a call among its membership for existing data and for help in gathering new data. The program is being carried out under the direction of Mr. Henry Hemmendinger.

NSF Aids Development Of Science Teaching Aids

OCCASIONALLY, AN ingenious scientist or engineer, dissatisfied with standard laboratory equipment for teaching science, will sit down and develop tools he feels will improve science instruction. The National Science Foundation has announced that it is helping 18 such innovators, to the tune of $189,000.

Projects being thus materially encouraged include modified research apparatus for quantitative experiments on the properties of waves, an inexpensive digital computer kit, dissectible models of skulls, an operating model to demonstrate the principles of hemodynamics in vertebrate circulatory systems, in inexpensive supersonic wind tunnel, and an electronic planetarium. Grants for these and other projects have been made by the Foundation to colleges, universities, professional scientific organizations, and research institutes.

The foundation does *not* provide for purchasing equipment for use by an individual school or college or for the development of equipment solely for local use. The objective is to aid competent scientists to develop new equipment for use generally. Grantees are expected to spread the word about their brain children in reports, articles in professional journals, and presentation at professional meetings. They are also expected to permit interested commercial suppliers to negotiate for production and marketing of their equipment.

Further information can be obtained from the Course Content Improvement Section, National Science Foundation, Washington 25, D. C.

OFFERS OF PAPERS FOR 1960

THE Administrative Committee on Papers and Publications will meet in early February to consider the papers to be published by the Society in 1960 and to develop the program for the Annual Meeting to be held in Atlantic City June 26–July 1.

All those who wish to offer papers for presentation at the meeting and publication by the Society should send these offers to Headquarters *not later than January 10, 1960.*

All offers should be accompanied by a summary that makes clear the intended scope of the paper and indicates features of the work that will, in the author's opinion, justify its publication and inclusion in the Annual Meeting program.

Suitable blanks for use in transmitting this information will be sent promptly upon request to Headquarters.

ASTM Bulletin

No. 241 October 1959

Nineteen-Sixteen
Race Street
Philadelphia 3, Pa.

Use Your Headquarters Research Reports File

AT THE FORUM on Research held at the Annual Meeting last June it was brought out very clearly that ASTM standards are based on a large body of research. This includes research sponsored by others and reported in the literature and research carried out within the ASTM committees to develop criteria for establishing standards. In the case of the committee research, only a small portion is ever published; the reports settle in committee files and become increasingly difficult to retrieve with the passage of time. The Administrative Committee on Research, long concerned with this problem, last year recommended that a permanent file of research reports be established at Headquarters.

The availability of the Headquarters file for use by the technical committees was announced in the BULLETIN (December, 1958, page 15); it was also brought to the attention of the committee officers by circular letter. We are again announcing that this file is available and that contributions from technical committees are welcome. Two copies of reports, approved by officers of the committee, should be submitted for the file, one for permanent safekeeping and the other for loan.

Papers to Appear in Future Issues of the ASTM Bulletin

A Reliable Technique for Measuring Brush Wear in an Atmosphere Containing Silicon Vapor—J. S. Axelson and F. M. Precopio, General Electric Co.

Preparation of Compression Molded Polyethylene Test Specimens—A. M. Birks and A. Rudin, Canadian Industries Ltd.

A New Technique of Calibration for Gas Permeation Measuring Apparatus—T. McAvoy, Hotpoint Co.

Measurement of the Crystallinity and Void Content of Articles Fabricated from "Teflon" TFE-Fluorocarbon Resins—N. G. McCrum, E. I. du Pont de Nemours & Co., Inc.

The Use of Ultrasonics in the Testing of Irradiated Fuel Elements—J. M. Fouts, General Electric Co.

Segregation in Aluminum—13 per cent Uranium Castings—D. Peckner, Materials in Design Engineering

Improved NBS Abrasive Jet Method for Measuring Abrasion Resistance of Coatings—A. G. Roberts, National Bureau of Standards

A Study of the Accelerated Aging of Vinyl Compounds in a Modified Testing Oven—Markus Royen, Apex Tire and Rubber Co.

Design Studies of Capsules for High-Temperature Irradiations—J. H. Stang, W. H. Goldthwaite, B. W. Dunnington, Battelle Memorial Institute

Control Testing for Separation of Lightweight Material from Aggregate—E. C. Higginson and G. B. Wallace, U. S. Bureau of Reclamation

An Instrument for the Determination of Impact Sensitivity of Materials in Contact with Liquid Oxygen—W. R. Lucas and W. A. Riehl, Army Ballistic Missile Agency, Redstone Arsenal

Should ASTM Change Its Name?

Those who know ASTM are familiar with its objectives: "The promotion of knowledge of the materials of engineering, and the standardization of specifications and methods of testing." These purposes have not changed over the years; they are still those for which the Society was organized almost sixty years ago—the evaluation of materials to ensure their proper use. During those years, many refinements have been made in testing methods, many new tools have become available, many new materials and new combinations and new applications of older materials have come into use. Statistical analyses have become of great importance in the evaluation of material properties.

With such broad concepts of the Society's stated purposes, the inevitable question has been asked: Does the present name of the Society adequately describe its functions? It is not so much that our purposes have changed over the years; it is rather that narrow concepts of the word "testing" have come into use—often as a synonym for "inspection" instead of the more comprehensive "evaluation" originally intended. In other words, "testing" has changed in meaning just as words like "technology" are changing.

At times, in view of our sole interest in materials, the comment has been made that we could rightfully be called "The Society for Materials." Such a name, however, would lack definiteness; there are dozens of societies interested in materials, usually in specific fields, without ASTM's emphasis on properties and standards.

Two names that have been suggested in the Board of Directors are: (1) Association for Standardization and Technology for Materials, and (2) American Society for Science and Technology of Materials. Both of these preserve the initials ASTM, which have come to be recognized the world over (both as an adjective and as a noun) as connoting authoritative standards for materials and the organization responsible for their formulation through the development of adequate knowledge to serve as a basis for them. It is important to keep the letters ASTM. It is even more important that the ASTM continue and develop the work for which it is known. If a change in name would help to expedite its work by indicating more clearly its true function, then a change should be considered. The comments and suggestions of the membership would be helpful and appreciated.

R.E.H.

MATERIAL QUESTIONS

Service Ratings for Materials

In your 1958 Book of ASTM Standards, Part 1, Ferrous Metals, a number of the specifications (A 155, A 192, A 193, A 194, and others) refer to "high temperature service." At what temperature do you consider high temperature begins? Also, A 192 and A 194 refer to "high pressure service." At what pressure does this begin?

● ASTM no longer establishes service ratings for most of the materials covered in its specifications. This is left to the Code body that uses ASTM material specifications by reference. For example, all of the specifications mentioned above have ratings established for them, so far as temperature and pressure is concerned, by the Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers.

Hardness of Plastics

We have a problem on measuring hardness of plastics for plastic tooling application. We have studied the various tests such as Rockwell M, F, and R; Shore A and D; Barcol; Vickers; and Brinell. We have not been able to find any information on correlation of these different tests. Could you supply information?

● Some instrument manufacturers, such as The Barber-Colman Co., publish correlation curves (Lithograph F-1689-2BK and F-1908-2). You will note that these are only approximate. Generally correlation curves are not recommended between instruments or even between the different scales of the Rockwell instrument. While you may be able to calibrate one instrument with another for one type of plastic there is no guarantee that the same correlation will hold with another plastic. Different plastic materials have different creep, penetration, and tear properties. Different instruments have different applied loads and penetrator shapes. You can readily see why correlation is not recommended.

In general, one can state that the Barcol GYZ 934 covers the E Rockwell scale and the top of the M scale, the Shore D covers the Rockwell R up to the hardness of Teflon and Shore A is mostly below the Rockwell R and into the Rockwell J scale using a $\frac{3}{4}$-in. ball penetrator and a 30-kg load. The Rockwell J scale has not proved satisfactory for plastics.

Conversion tables do exist in the metals field, since indentation hardness readings do not have as wide a spread as in plastics, where hardness readings vary from values almost as hard as glass down to the range of rubber-like materials.

The scales chosen for these materials are Rockwell R, L, M, and E in increasing order of hardness. Several intermediate Rockwell scales have been ignored as they introduce considerable overlap. We do not consider any correlation to be valid over any extended range of one scale with another.

Normally the range of any one Rockwell scale is from 100 to 115 divisions. Quite often readings around 120 are given but we do not consider them valid due to the small indentation and crowding of the readings. Some overlap exists between adjacent scales but it is not sufficient to be of much value. Consequently we do not recommend that such tables be used.

Cellular Materials

Please inform us of the present status of test methods and specifications for cellular materials especially the cellular plastics of polyurethane, poly(vinyl chloride), polystyrene, and polyethylene.

● Seven standards relating to cellular materials have been approved by the Society as follows:

D 1055 – 56 T Spec. and Methods of Test for Latex Foam Rubbers
D 1056 – 56 T Spec. and Methods of Test for Sponge and Expanded Cellular Rubber Products
D 1564 – 58 T Methods of Test for Flexible Urethane Foam
D 1565 – 58 T Spec. and Methods of Test for Flexible Foams Made From Polymers or Copolymers of Vinyl Chloride
D 1621 – 59 T Method of Test for Compressive Strength of Rigid Cellular Materials
D 1623 – 59 T Method of Test for Tensile Properties of Rigid Cellular Materials
D 1622 – 59 T Method of Test for Apparent Density of Rigid Cellular Materials

The first four listed above were developed by ASTM Committee D-11 on Rubber and Rubber-Like Materials in cooperation with the Society of the Plastics Industry. The three test methods for rigid cellular materials were developed by Committee D-20 on Plastics also with SPI cooperation. The plastics committee is currently developing analytical tests for the chemical intermediates used in the manufacture of cellular plastics.

Schedule of ASTM Meetings

This gives the lastest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
Nov. 2–3	Committee B-9 on Metal Powders and Metal Powder Products	Chicago, Ill. (Bismark Hotel)
Nov. 5	Committee D-15 on Engine Antifreezes	New York, N. Y. (Statler Hilton Hotel)
Nov. 5–6	Committee F-1 on Materials for Electron Tubes and Semiconductor Devices	Skytop, Pa. (Skytop Lodge)
Nov. 5–6	Committee D-14 on Adhesives	Cleveland, Ohio (Case Inst.)
Nov. 6	Committee E-13 on Absorption Spectroscopy	New York, N. Y. (Hotel New Yorker)
Nov. 12	New England District	Boston, Mass.
Nov. 12–13	Joint Committee on Leather	Philadelphia, Pa. (Benjamin Franklin Hotel)
Nov. 18	Committee E-11 on Quality Control of Materials	Philadelphia, Pa. (Society Headquarters)
Nov. 18	Southeast District	Oak Ridge, Tenn.
Nov. 18–20	Committee D-27 on Electrical Insulating Liquids and Gases	New York, N. Y. (Governor Clinton Hotel)
Nov. 19	Philadelphia District	Easton, Pa. (Lafayette College)
Nov. 19	Detroit District	Detroit, Mich.
Nov. 19	Central New York District	Schenectady, N. Y.
Dec. 10	Committee D-21 on Wax Polishes and Related Materials	Washington, D. C. (Mayflower Hotel)
1960		
Jan. 18–20	Committee A-1 on Steel	Philadelphia, Pa. (Warwick Hotel)
Jan. 24–27	Committee D-19 on Industrial Water	Atlanta, Ga. (Atlanta-Biltmore Hotel)
Jan. 27	New York City District	New York, N. Y. (Engineering Societies Bldg)
Jan. 31–Feb. 5	Committee D-2 on Petroleum Products and Lubricants	Detroit, Mich. (Statler Hotel)
Feb. 1–5	**Committee Week**	**Chicago, Ill. (Sherman Hotel)**
Feb. 9	Southwest District	Houston, Texas
Feb. 11	Southwest District	Dallas, Texas
Feb. 15–17	Committee D-1 on Paint, Varnish, Lacquer, and Related Products	Washington, D. C. (Shoreham Hotel)

Research Today . . . for Better Roads Tomorrow

This is a condensation of an address delivered by Ellis L. Armstrong, U. S. Commissioner of Public Roads, at the 62nd ASTM Annual Meeting.

IN THE DYNAMIC economy of modern America research is a mighty force. We in the highway field have the responsibility to build better, longer-lasting pavements and structures at the lowest possible cost. It is to a very considerable extent through the efforts of the members of this Society that we are able constantly to advance toward that goal. Continued research is the key to an even better future.

Materials and supplies represent nearly 50 per cent of construction costs. In this year of 1959, some $2.7 billion will be spent on steel, cement, bitumens, lumber, aggregate, pipe, petroleum products, explosives, paints, and almost countless other products—all of them measured in thousands or even millions of pounds, tons, gallons, or feet. With such staggering quantities involved, it is essential that we improve existing materials and develop new ones; always with the goal of increasing both quality and economy.

Soils

Among the varied ingredients of highway construction, there is one that we do not have to buy in a processed state—the soil that serves as the pavement structure subgrade. It is there, on site, and we must make the best of it. Soil is perhaps our most important, and also one of our most troublesome, materials. The use of ASTM standard soil tests has resulted in improvements in construction procedures and in the serviceability of soil structures. However, there are several areas in which much research is needed. Some progress has been made in the stabilization of plastic, fine-grained soils, which we must use in large quantities. Portland cement and lime are being used extensively and have given good results with some soils. Research is now being carried on by a number of major chemical companies in cooperation with the Bureau of Public Roads in an effort to develop a chemical that will stabilize any type of soil at low cost. One promising material is now being field tested. "Magic" chemicals have come and gone in the past, tried and found wanting. Nevertheless, the goal is worth the searching and we must continue to seek.

In an effort to discover the working mechanisms of soil stabilization and to broaden our general knowledge of soils, considerable progress has been made, but much remains to be done. The clay minerals, which are basic soil constituents, are being fingerprinted by X-ray diffraction, differential thermal analysis, electron microscopy, and base-exchange. It is through such basic research that we can learn to identify materials, acquire an intimate knowledge of their nature, and ultimately find ways to take full advantage of their individual characteristics.

Information on the effect of repetitive loading on the strength of subgrade soils is needed for use in the design of both rigid and flexible pavements. Current laboratory research indicates that soil deformations caused by repetitive loads vary greatly from those developed under static loading. Traffic-induced loads on subgrades are repetitive in nature, but most of the soil-strength tests being used in estimating subgrade bearing capacities are of the static-loading type. Research in this area should be accelerated and an effort made to correlate the results with the findings from the AASHO and WASHO road tests.

Progress has been made in the development of nuclear equipment for field measurement of moisture and in-place density of soil and soil-aggregate mixtures. Several of these devices are now being given field trials. When perfected, their use should result in more accurate control and greater uniformity of compaction and possibly more economical use of construction equipment.

Bituminous Materials

Consideration of flexible pavements directs attention to bitumen, the cementing agent. Bitumen in some form has been used as a waterproofing or cementing material since the days of the Pharaohs. Initially it was used as found in nature. Later, by-products from the manufacture of coke and gas and from the refining of petroleum came into use as binders in surfaces for highways. We have learned to use these materials principally by trial and error. Current methods of test are empirical, and specified properties of the materials are based on empirical relations. No major developments toward greatly improved bitumens or better techniques for their use are likely until truly scientific determinations of the properties of these materials can be established. We must apply in bituminous research the scientific apparatus and techniques developed for related fields. These include "fingerprinting" determinations involving chromatography, infrared and ultraviolet spectroscopy, as well as spectroscopy involving nuclear magnetic resonance.

Although there are several classes of bituminous products which have a place in our highway program, the backbone of bituminous pavement construction is necessarily asphalt derived from petroleum. Priority must be given to studies of this material. Because of its complex structure, we must separate asphalt into its components and determine the contribution of each to the over-all physical properties and durability of the pavement constructed with it. We must determine, scientifically and accurately, the engineering properties of asphalts based on fundamental considerations. We need to know the absolute viscosity and the changes that occur in this viscosity with temperature or pressure. The hardening of asphalt with age and its effect on pavement properties must be determined.

As the ultimate result of such a program of research, the engineer should be able to specify the properties desired for a binder and the asphalt producer should be able to furnish a product to fit these needs. We can visualize a material that will be liquid or thermoplastic in the construction stage but, once in the pavement, will become essentially independent of temperature variations. It will retain its flexibility, toughness, and adhesiveness at extremely low temperatures and not become soft at high temperatures.

We need only to look at the progress in the petrochemical and plastics fields

to realize what can be done. (See box—Ed.) Relatively little "natural" gasoline or lubricating oil is on the market today. Gasolines or other fuels are tailormade to suit the needs of modern combustion engines. Lubricating oils are modified or treated with additives to increase their efficiency and resistance to heat. In the plastics field a wide range of materials has been developed to meet an equally wide range of needs. Thermosetting materials, for example, make use of a curing agent or catalyst to produce a hardened resin at normal temperatures which, after curing, will not soften with heat.

Such developments are easily within the realm of possibility—yes, even probability—for bituminous highway materials. We have the motivation; we need only the direction and financing for a program of research that will reach beyond the immediate day-to-day problems. Although the costs of specialized materials that might be developed may seem prohibitive, we must keep in mind that volume production and experience can in many cases eventually reduce the cost of new and improved materials to a point below the cost of the original "natural" material.

Actually, some progress in this general direction is being made. The use of rubber and other high polymers as a blend with asphalt to improve its properties is being tested on a broad scale. More recently, the admixture of resins with asphalts to provide a tough, resilient product for special applications has been accomplished. Quite a number of additives now on the market are designed to improve the adhesion of the asphalt to stone and to prevent damage from water. True, many of the claims for these materials are controversial, and a carefully planned program of research is needed to weed out the fact from the fancy.

After a bituminous pavement has been built, it is frequently desirable to determine the density and stability of the pavement material. To expedite and facilitate these studies, methods for the testing of bituminous pavements in place are needed. Research should develop such tests, using whatever means can be found.

The use of epoxy resins for joining new and old concrete and for cementing antiskid coatings to existing pavements is a new and successful, but rather expensive, development. Research is warranted to develop less expensive materials with the same properties, or to extend or improve the use of the epoxies in order to obtain less costly repairs.

Infrared spectroscopy has long been used in organic chemistry for the detection and identification of complex substances. Its application to studies of asphalts has been mentioned. It should also be suitable for use in identifying organic materials in the myriad of admixtures proposed for portland cement, bitumens, and paints. Improvements in pigments used for paints for bridges have recently been made. Research should follow this development to ensure paints of longer life and greater protective ability.

"When one realizes. . .that approximately one-half of the compounds listed in the API tables have never been prepared by man, but are nevertheless characterized by data which are believed to be accurate, it becomes evident that exceptional contributions are being made to the science of petroleum chemistry.

". . .To illustrate, Dr. John B. Greenshields and Dr. F. D. Rossini advise that there are theoretically 366,319 isomers of the paraffin hydrocarbon $C_{20}H_{42}$. Selecting one of these isomers, namely, 2,2,3,7,8,8-hexamethyl - 5 - ethyl - 5 - *iso*-propylnonane, they have calculated the following data:

Boiling point, deg C, at 760 mm of mercury	279.9
Density at 25 C, g per ml	0.8275
Refractive index, n_D, at 25 C	1.4595

These men, Dr. Rossini and Dr. Greenshields, are confident, the petroleum industry is confident, and the scientific world is confident that these are true properties of a compound which has never been made or isolated to date."

...From "The API Balance Sheet on Properties of Hydrocarbons," by W. E. Kuhn, presented at the 24th Midyear Meeting of the American Petroleum Institute's Division of Refining, New York, May 29, 1959.

Portland Cement Concrete

So far, I have said little about portland cement concrete and its use in highways and associated structures. In the past few years, research has furnished much information that has been applied to give us better concrete. Concrete is an excellent material, but we do admit there are still some problems. Not the least of these is volume change.

If we could make a concrete pavement that did not change volume, we could furnish the motorist an ideal pavement. There would be no joints and no rough riding. With utopian cements and aggregates, the pavement would last as long as needed, and maintenance would be nil. But with present-day materials we cannot obtain a concrete that remains constant in volume. Some progress has been made toward obtaining a hydraulic cement of low volume change. Commercial production of such a cement would be followed by a great improvement in the quality of concrete.

In a different approach, if we consider the use of portland cement as now manufactured, there are several things we could do to obtain concrete with a very much smaller amount of volume change. Portland cement concrete requires the use of a small amount of water to hydrate the cement and an additional amount to make the concrete plastic enough to place. This additional amount of water aggravates the inconstancy of volume of concrete, and means for reducing it should be sought.

One method might be the substitution of mechanical effort for a portion of the

Courtesy U.S. Bureau of Public Roads

Rolling pavement of northbound lane on U.S. 240 at Rockville, Maryland.

"Bitumen in some form has been used as a waterproofing or cementing material since the days of the Pharaohs."

excess water. If the amount of water used is just that necessary to hydrate the cement, with the barest minimum additional to provide some mobility to the concrete, the strength and durability of the concrete should exceed greatly that now obtained under the most favorable condition. Of course the placement of this concrete will be a major task and our present concepts of mechanical equipment will have to be altered drastically. However, in pavements especially, some such development should be practical.

A second concept for consideration in the improvement of portland-cement concrete involves the use of water for hydration and the use of a second dissimilar liquid to furnish the mobility of the concrete. This second liquid should be of such a nature than an emulsion with water could be prepared. After the concrete has been placed, the emulsion would break, releasing the second liquid and permitting it to evaporate. Such a liquid is now unknown, and here is a real research challenge. It should be inexpensive, highly volatile, and nonreactive with cement. Prolonged manipulation of the concrete to promote the removal of the mobilizing liquid presumably would have to be considered.

A third concept is the addition to the concrete mix of some yet undiscovered material which, after dissipation of the mobilizing water and the hydration of the cement, would maintain the residual water content at a constant level, thereby minimizing the volume changes of the concrete. It is expected that use of an additive having this property would also eliminate the need for external curing of concrete.

The construction of portland-cement concrete pavement by means of slip-form pavers is a splendid example of the development through research and trial of an effective method of construction from a nebulous idea, originally deemed impractical. Similar "impractical" machines will inevitably become practical as improved or new materials, sources of power, and technological discoveries are developed.

New Concepts Needed

Who knows but what, in some future year, a self-propelled machine will in a single operation level the native soil and transform its topmost layer into a smooth, permanent pavement? A brand-new concept? Not entirely. A few old-timers may dimly remember the experiments with burnt-clay roads, shortly after the turn of the century. The clay surface was furrowed and covered with ricks of cordwood on which more clay was piled. Then the wood was ignited and, after the conflagration, there was left a layer of clinker which was rolled and shaped as the road surface. It was a promising idea, but not too successful, and long since cast aside. And yet, perhaps this crude effort of the 1900's may flower into successful practice, at the turn of the next century, with utilization of atomic energy or concentrated solar heat.

Returning to today, the users of our highways are often disagreeably conscious of the bridges because of the bumps at both ends. Some success is being achieved in matching the firmly supported bridge end to the time-yielding support of the approach pavement, but it is clear that a full solution to this problem is yet to be found and put to general use.

Unfortunately, the rough ride on the bridge approach too often continues across the bridge. Some engineers, by dint of painstaking care in design and construction control, have achieved smooth bridge decks, even over continuous spans where the successive setting-up of concrete floor slab sections often freezes the spans in irregular profile patterns. Those most successful in meeting this problem have used long, longitudinal strike-offs. Perhaps the move toward economical machine-finishing of concrete bridge decks might well turn toward the development of mechanically sound devices employing the principle of the longitudinal strike-off.

The most promising means for securing desirable riding qualities on concrete bridge decks may lie in the use of retarders to control the setting of the concrete. The entire span or group of continuous spans could then be finished after all concrete has been placed and is still sufficiently plastic to permit the spans to take the normal computed deflections for which the camber and profile were designed.

Progress is being made in the utilization of metals. The use of welding and of high-strength bolts is advancing rapidly, accompanied by the appearance of many new problems and their solution. Improvements in riveting practice can be foreseen. The new high-strength AREA steel, used in the New Orleans Bridge, and the weldable, high-strength T-1 steel used in the Carquinez Bridge, are products of continuing development.

Courtesy U.S. Bureau of Public Roads

Paving operation on the Palmer Highway near Lanham, Maryland.

"If we could make a concrete that did not change volume, we could furnish the motorist an ideal pavement."

The use of aluminum, in forms appropriate to its special properties, is being advanced through imaginative rational design and research which may show the way toward better forms for the use of other materials.

No discussion of research for highways would be complete without reference to the safety of the public. For example, the hazards of driving at night could perhaps be decreased by the use of luminous or reflectorized surface coatings on pavements. The use of such coatings at dangerous locations such as grade crossings and the approach lanes to roads carrying high-speed traffic could add greatly to the safety of driving. In some locations, the coatings might well include skid-resistant properties.

In this discussion of research, I cannot fail to mention specifically the greatest highway research project of all time, the AASHO road test now under way in Illinois. There, literally miles of pavements of varying types and designs are being subjected to countless repetitions of a wide range of vehicle loadings. From this test will come, I am sure, great improvement in the present empirical methods of pavement design. But even more important may be the ultimate development, from the mass of data collected, of basic scientific principles and rational theories of design.

We have available to us an even larger testing ground than the AASHO test road, for in our highway systems we have the largest road laboratory in the world. It is a laboratory where every conceivable exposure of highway materials to treatment by mankind and to the effects of the elements has been provided. It only remains for us to read and interpret the results of these tests. We must not neglect this source of information. In this great laboratory, and in individual laboratories across the land, I know that the members of the ASTM will be in the forefront, aiding us to build better roads for a better America. There is much to be done!

Know Your Committee Officers

To better acquaint Bulletin readers with the men who direct the indispensable work of the ASTM technical committees.

Committee D-11 on Rubber and Rubber-like Materials

Simon Collier
Chairman
Johns-Manville Corp.
New York, N. Y.

H. G. Bimmerman
Vice-Chairman
E. I. du Pont de
Nemours and Co., Inc.
Wilmington, Del.

J. J. Allen
Secretary
Firestone Industrial
Products Co.
Akron, Ohio

Committee C-12 on Mortars for Unit Masonry

R. E. Copeland
Chairman
National Concrete
Masonry Assn.
Chicago, Ill.

Harry C. Plummer
First Vice-Chairman
Structural Clay Products
Inst., Washington, D. C.

P. M. Woodworth
Second Vice-Chairman
The Waylite Co.
Chicago, Ill.

C. U. Pierson, Jr.
Secretary
Southern Cement Co.,
Birmingham, Ala.

A Pig Is a Pig Is a Pig

How many hours do you waste every week in trying to read and decipher inflated prose? Here is a plea for more plain talk among technical people.

The following describes the activities of five immature mammals of the family of nonruminant artiodactyl ungulates. All five of these may be described as being of less than average magnitude; however no information is given as to the relative size of one with respect to another. Available evidence indicates that the first of the group proceeded in the direction of an area previously established for the purpose of commerce. Data on the second of the group clearly show that, at least during the time period under consid[illegible]ation, it remained within the confines of its own place of residence. Reports received on the activities of the third member of the group seem to show conclusively that it possessed an unknown quantity of the flesh of a bovine animal, prepared for consumption by exposure to dry heat. The only information available on the fourth member of the group is of a wholly negative nature, namely, that its possessions did not include any material of the type previously described as having been in the possession of its predecessor in this discussion. As to the fifth and last member of the group, fairly conclusive evidence points to its having made, during the entire course of a movement in the direction of its place of residence, a noise described as "wee, wee, wee."

Try that one on your two-year-old's piggies. Ten to one you lose your audience before you draw your second breath. Absurd? Then how about this: You are asleep below-decks in a ship in mid-Atlantic. The night is black, the seas stormy. You are suddenly awakened by the crash of alarm bells, hysterical shouts, the pounding of running feet overhead. Panicked, half-dressed, you grope your way through a darkened ship to the deck. All about you are pushing, screaming bodies. The ship is sinking. Then a sign appears in front of you, barely legible in the faint moonlight. Hungrily, you make out the words: "Locations of auxiliary vessels, which are to be utilized by personnel only in the event of the necessity for the abandonment of this ship, are as follows. . ." Before you can read further, the milling mob carries you out of range.

These are two examples of stifled communication. In each case the culprit is overblown language, big words, pompous style, complex syntax, indirection. Does the style sound familiar? It should; most people, especially technical people, seem to fall into that style naturally. Until a few years ago, this was merely unfortunate. We were like the little two-year-old who was deprived of his nursery rhyme. Now, however, we are in the position of the hapless soul on the sinking ship—failure to communicate is a danger, may prove to be fatal.

Progress in every field of human endeavor leans heavily on our ability to tell others what we think and feel, what we have found out, and what we intend to do next. Failure to communicate is at the root of many of our social problems—personal, national, and international. This is fairly obvious. Another word for a quarrel is a misunderstanding.

What may not be so obvious is that failure to communicate is seriously retarding technological progress. Leave aside the fact that engineers and scientists are not able to tell laymen about their findings, their philosophies, their hopes. This is an extremely dangerous situation that has been the subject of countless editorials in the recent past. Beyond that is the sad fact that technical people are unable to communicate among themselves. Scientific knowledge is accumulating faster than we can disseminate or digest it. Fifty years ago this would have been deplorable. Today it is perilous. From all sides we hear that scientific and engineering manpower is in short supply, that the efficient use of what we have may make the difference in our struggle for national survival. At the same time, untold thousands of man-hours are wasted every day in the struggle to wrest meaning from the jargon-infested jungle of our technical literature.

What are the reasons for the high impedance level in technical writing? What can be done to speed the flow of knowledge that is so vital to ourselves and to our nation? There are four basic reasons why we write the way we do. Once we understand these, the cure is obvious.

1. We use big words to impress people.
2. We are indirect because it seems more "polite."
3. We use weasel words to hide behind.
4. We use high-blown language because it's easier to write.

Big Words. People may be impressed by big words, but we should be writing to inform them, not to impress them. Just because our subject matter is serious, just because we are professionals writing for professionals, is no reason for us to get up on our high language horse. We should not fear that we may seem to be talking down to our readers. A Ph.D., no less than plain folks, appreciates plain talk. The urge to break out into fancy language may be a hangover from the days when the Fourth-of-July orator was much admired by the voters for his ability to disgorge great streams of polysyllabic profundities in a gaudy display of verbal pyrotechnics. It went well with the fireworks. Much smoke was generated; very little light was shed on anything. The truth of the matter is that the short, plain word is usually better than the long one. It is usually less abstract, more concrete, has greater impact. It tells the story faster, more accurately, with less wear and tear on the reader. Mark Twain once said, "I never write 'metropolis' when I can get the same price for 'city.'" Let us heed his tongue-in-cheek message.

Indirection. Somehow, we shy away from putting the plain, open truth down on paper for all to see. We would rather hedge the truth about with fancy works, veil its nakedness with misty abstractions. A man writes a letter: "Dear Sir: We regret to inform you that the widgets you ordered are temporarily out of stock. As soon as they become available we shall be happy to accommodate you." It's a little minuet in words—a dancing and mincing about on the fringes of truth with "polite" expressions designed to hide the kernel of

truth that is buried there. Why not write: "Dear Sir: I'm sorry, we have no widgets in stock right now. We'll have more in about a week, and we'll send them to you then." Too blunt? Hurt your sensitivities? Let's learn to face the facts. It will save everybody a lot of time.

Weasel Words. This sickness is closely related to the one we just discussed. The difference is that we use indirection out of a vague fear of hurting the reader's feelings; whereas we use weasel words out of a fear of revealing ourselves. Writers of technical papers, in particular, quail at the thought that they may be accused of leaving a stone unturned, failing to consider all the angles, being less than perfectly objective, or drawing a conclusion that is unwarranted by the evidence. All these are, of course, sins. But in giving the appearance of avoiding them, writers qualify, modify, water down, temper, limit, hedge about, and throw up a dense smokescreen of words through which the truth can be seen only with great difficulty. "All the available evidence appears to indicate that. . ." "The tentative conclusion, based on the data presented, is that. . ." "While it has not been possible with the results obtained herein to arrive at a definite conclusion as to the. . ." We are all familiar with this sort of thing. The shelves of our libraries sag under the weight of it.

The Easy Way. It may seem a paradox, but it is nonetheless true that high-blown language is easier to write than simple, direct language. Indeed, one of the definitions of poetry is economy of expression—saying the most with the fewest words. Look at any of the masterworks of the English language, and you will find use of the shortest, most direct word to express the thought. The Bible is an outstanding example of this—the words are simple, clear, beautiful; the thought is profound. Churchill did not promise his people "dangers, exertions, difficulties, and anxieties." He worked a little harder on what he had to say and came up with "blood, toil, sweat, and tears."

The reason complex language is easier to write than simple language is that the longer words are usually more vague, more abstract—if you use them, you don't need to be so precise. You can let the words flow without making the distinct effort needed to find out just exactly what you want to say. Thus: "The results indicate that the effect of the type of surface treatment utilized in this investigation is to mitigate the detrimental effects of stress concentrations on fatigue strength." Abstractions such as "effect," "surface treatment," "investigation," "detrimental effects," included in the same sentence with such monstrosities as "utilized" and "mitigate" are almost too much even for the reader whose life depends upon knowing the result. How much is lost to science by simply saying "These tests show that shot peening increases the fatigue strength of notched steel bars."? Help save the life of that poor wretch on the sinking ship. Put up signs saying "This way to the lifeboats." Remember, too, that all your readers may not be drinking your words with quite as compelling a thirst.

In summary: Write to inform your reader, not to inflate your own ego. Use the short, direct, concrete words that tell exactly what you mean. Be direct. Don't fear that by telling the naked truth you will step on somebody's toes. Let them know the truth. The truth will set them free. Don't weasel. Find out what you want to say, and say it. Don't veil imprecise thoughts in cloudy abstractions. Work at writing. Give at least as much effort to the report as to the project itself. You will be twice blessed.

A. Q. M.

This is one of a series of photographs from a collection compiled by Prof. Jasper O. Draffin and displayed in the Arthur N. Talbot Laboratory, University of Illinois.

ROGER BACON (1214–1294). English philosopher and scientist. Studied calendar reform, meteorology, mechanics, optics. Stressed the importance to science of mathematics and of experiment. Was the first European to appreciate the power inherent in gunpowder. Foresaw flying machines, mechanically propelled boats, circumnavigation of the globe.

"It is a wretched argument that is supported by custom and tradition."
. . . Compendium theologiae

"To neglect knowledge is to neglect virtue . . . The true and the good are one; in order to do good one must know it; in order to avoid evil one must discern it; ignorance is the mother of sin."
. . . Opus tertium

Technical Committee Notes

Cellulose and Its Derivatives

At a meeting in Atlantic City, N. J., on September 16, 1959, Committee D-23 on Cellulose and Cellulose Derivatives reviewed its completed interlaboratory test program to verify the proposed chromatographic method of analyzing chemically refined cellulose pulps. Eight collaborating laboratories analyzed five mixtures of glucose, mannose, and xylose as received and after simulated hydrolysis. In addition, analyses were made for the mannan and xylan content of the five standard cellulose samples jointly sponsored by the committee and the International Committee on Cellulose Analyses.

The results of this study were analyzed statistically to determine the accuracy and precision of these techniques. This information will be used as a basis for the precision and accuracy section of the new proposed procedure for chromatographic analysis of cellulose approved for submission to the Society for publication.

An interlaboratory comparative study of the aniline acetate, orcinol, and bromination methods for the determination of furfural in pentosan distillates from the ICCA standard cellulose pulps has been completed. The completed study shows that the orcinol method is the most precise of the three methods.

Further methods of characterizing cellulose acetate (Method D 871) are being submitted to the committee. These include: heat stability, combined sulfur, hydroxyl content, intrinsic viscosity, and color and haze. The combined acetyl or acetic acid content determination of Method D 871 is also being revised.

New Committee C-24 On Joint Sealants Is Organized

The magic number is now 81, there now being 81 technical committees within the framework of ASTM as of September 15. On that date Committee C-24 on Joint Sealants became the newest member of the ASTM family.

An attendance of 65 at the organization meeting was a good indication of the wide interest in this new activity. It was interesting to note that a new segment of industry, not heretofore active in the Society, will participate in the development of standards for a number of types of sealing compounds. Two industrial groups now active in the development of standards, the Rubber and Plastic Adhesives and Sealants Manufacturers Council and the Building Trades Specifications Committee, will coordinate their activities as well.

A change in title, as well as scope, from that previously announced, was agreed upon. The revised title and scope will mean that sealants other than elastomeric, applicable to the sealing of joints and openings, will be considered. A wider range of end-use applications will also be covered, with aircraft, highway, and building construction to receive attention.

The scope now reads:

> "The promotion of knowledge, stimulation of research and the development of methods of tests, specifications and nomenclature of materials for sealing joints and openings. Such sealants include caulking and glazing compounds and preformed gaskets and tapes. These activities will be coordinated with those of other relevant committees of ASTM."

Officers selected for the current term:

Chairman: Wayne F. Koppes, architectural consultant
Vice-Chairman: R. K. Humke, Minnesota Mining and Mfg. Co.
Secretary: J. R. Panek, Thiokol Chemical Corp.
Membership Secretary: H. F. Kleinhans, Pawling Rubber Corp.

The newly elected officers and the members of the steering committee, which handled the organization, were authorized to act as a temporary executive subcommittee with added representation from the highway and aircraft fields.

Working subcommittees, reflecting the emphasis on end use, as observed in the discussion at the organization meeting, will be formed initially to cover: Nomenclature; Bulk Compounds; and Gaskets and Tapes.

The next meeting of the committee will be at the call of the executive subcommittee, depending primarily upon the progress made in the organization of the working subcommittees.

District Activities

ST. LOUIS

New Energy Sources

SPEAKING BEFORE a joint Meeting of the St. Louis District and the St. Louis Engineers Club, ASTM Vice-President A. Allan Bates, vice-president, research and development, Portland Cement Assn., discussed "The Impending Energy Revolution."

The meeting, held Thursday, October 1, was originally planned for the new Engineers Club as part of a program to inaugurate the new facilities. When this proved impossible, the meeting was moved to the campus of Washington University.

Dr. Bates joined the Portland Cement Assn. in 1946 after ten years as manager of chemical, ceramics, and metallurgical research at Westinghouse Electric Corp. He is a member of the Building Research Institute and of the Executive Committee of the Building Research Advisory Board, both units of the National Academy of Sciences—National Research Council.

In his slide-illustrated talk, Dr. Bates discussed new and exotic energy sources. He pointed out that "futuristic" fuels may be used on a daily basis because of the rapid approach to an economic equivalent to currently used fuels.

Arrangements for the meeting were made by A. C. Weber, Laclede Steel Co., secretary of the District. W. C. Magruder, Carter Carburetor Co., is chairman.

COMING DISTRICT MEETINGS

Date	District	Speaker	Place
Oct. 27	Pittsburgh (Joint with SAE)	Stewart Way	Mellon Inst.
Nov. 12	Washington	Panel discussion on packaging and labelling	Richmond, Va.
Nov. 12	New England	F. L. LaQue	Boston
Nov. 18	Southeast	F. L. LaQue	Oak Ridge, Tenn.
Nov. 18	Central New York	M. N. Clair and F. V. Lenel	Schenectady
Nov. 19	Detroit	A. A. Bates	Detroit
Nov. 19	Philadelphia	F. L. LaQue	Easton, Pa.

ACR Notes

Administrative Committee on Research

A Promising Trend in Student Employment

BY WALTER J. SMITH[1]

MANY COLLEGE students in science and engineering returned to their classes this fall with a better understanding and a more enlightened appreciation of the professions for which they have chosen to study. At the same time, many laboratories have profited by the summer employment of these students and have marked some of them as promising material for continuing or future consideration.

The growing practice of hiring college students for laboratory work during the summer months is one result of the sharp competition for technical help that has developed since the Korean conflict. Formerly, organizations seeking new young men were content to scout the senior classes of technical schools and colleges as graduation day approached. Now they are reaching well back into the undergraduate body to find and claim the better men even while their choices are still in the development stage.

Until a few years ago the science or engineering student on summer vacation had to follow much the same employment pattern as those in other fields of study. Short-term jobs such as camp councilor, lifeguard, waiter or bellboy at the resort hotel, or salesmen were the usual possibilities. Today, prompted both by the desire to "pick them early" and to meet the emergency need for temporary help, more and more employers are taking technical students into their laboratories and development shops for summer work. Offers are made generally to men of all classes from freshman to graduate, with emphasis on the students of greater promise and on those with skill who can perform usefully at once.

Like many simple devices, summer employment of technical students works remarkably well and benefits everybody.

By working in the very atmosphere of his intended career and in association with practicing professionals, the student gets a preview of where his studies will take him. If his expectations are confirmed, he is inspired, does excellent work for his employer, and returns to school with new zest. If he is disappointed he may wish to re-evaluate his choice of studies and he can be glad there is still time to change his school program. In any case, he has earned as much money as in a trifling job, or more.

If given an assignment within his capacity and properly supervised, a good student employee can do some remarkably effective work. His help is especially welcome at the very time when summer vacations have reduced the normal laboratory working staff.

As in all hiring, the employer must choose carefully, of course, but if an error has been made, the commitment is not a heavy one and there need be no obligation toward the man beyond the few months of that year. If, on the other hand, the choice proves to be a good one, the employer is in an excellent position to get the same student back each summer and to acquire him permanently upon graduation. Even under the best conditions, selection of technical personnel is very difficult. In most cases, the final evaluation can be made only by direct observation under actual working conditions. In long-range planning the student employee program permits this practical assessment to be made at small risk to the employer.

In view of the recognized need to increase the flow and quality of new scientists and engineers into the nation's laboratories, it would seem that summer employment of qualified students should be further stimulated. There are still many more eager and able applicants than there are summer jobs to be filled.

[1] Chemical Engineer, Arthur D. Little, Inc.,

STANDARDS AT WORK

ASTM in the Toy Box

SCALE MODELS of trains, automobiles, and construction equipment are still among the favorites in Junior's toy box. More and more, these items are being made of injection molded plastics.

Plastics manufacturers offer toy manufacturers a variety of plastics to meet specific requirements. Materials tailored to survive head-on collision with the floor, heat trials on the radiator, and extended outdoor weathering are called for. Assisting both materials suppliers and toy manufacturers, ASTM has prepared numerous standards to define such physical properties as heat distortion (ASTM Standard D 648), impact strength (D 256), hardness (D 676), water absorption (D 570), and flammability (D 635). This is another example of how ASTM helps industry through research and standards for materials.

The
Instituto Guatemalteco Americano
a non-profit, educational institution dedicated to the establishment of good understanding between the people of Guatemala and the United States
presents this Diploma of Honor to the
American Society For Testing Materials
in grateful recognition of its contribution to the Book Fair held in the National Palace of Guatemala,
May 15-30, 1959.

Diploma of honor presented to the Society for taking part in a Book Fair sponsored by the Instituto Guatemalteco Americano held in the National Palace of Guatemala, May, 1959. The Society takes part in several book displays each year at meetings of technical and educational organizations in the United States and elsewhere throughout the world. The book displays are a part of the Society's educational program to stimulate wider interest in the research and standardization work of the Society and its technical committees.

Actions on Standards

THE ADMINISTRATIVE COMMITTEE ON STANDARDS is empowered to pass on proposed new tentatives and revisions of existing tentatives, and tentative revisions of standards offered between Annual Meetings of the Society. On the dates indicated the Standards Committee took the following actions. Anyone interested in securing copies of the standards should write to Headquarters regarding their availability.

Steel

Tentative Specification for Alloy-Steel Turbine Type Bolting Material Specially Heat Treated for High-Temperature Service (A 437 – 59 T)

New Tentative.—This specification covers alloy-steel bolting material specially heat treated for high-temperature service, such as steam turbine and gas turbine use. The term "bolting material" as used in this specification covers rolled or forged bars, bolts, nuts, screws, washers, studs, and stud bolts. Two levels of bolting strength are covered, designated grades B4B and B4C.

Tentative Specification for Alloy-Steel Bolting Materials for High-Temperature Service (A 193 – 58 T)

Revision.—The chemical composition requirements for grade B5 have been changed to agree with those for AISI type 501 stainless steel; grades B7A, B8D, and B8F have been deleted; and AISI type 316 steel, designated as grade B8M, has been added.

Tentative Specification for Carbon and Alloy Steel Nuts for Bolts for High-pressure and High-Temperature Service (A 194 – 58 T)

Revision.—The chemical composition requirements for grade 3 have been changed to agree with those for AISI type 501 stainless steel, and grade 8D has been deleted because this steel is little used.

Tentative Specification for Seamless Ferritic Alloy Steel Pipe for High-Temperature Service (A 335 – 55 T)

Revision.—In Section 4 on Heat Treatment, the first sentence of Paragraph (*a*) has been changed by the addition of reference to the term "isothermal annealing" as defined in the Definitions of Terms Relating to Heat Treatment of Metals (E 44 – 50 T).

Tentative Specification for Alloy-Steel Bolting Materials for Low-Temperature Service (A 320 – 58 T)

Tentative Specification for Seamless and Welded Steel Pipe for Low-Temperature Service (A 333 – 58 T)

Tentative Specification for Forged or Rolled Carbon and Alloy Steel Flanges, Forged Fittings, and Valves and Parts for Low-Temperature Service (A 350 – 58 T)

Tentative Specification for Ferritic Steel Castings for Pressure-Containing Parts Suitable for Low-Temperature Service (A 352 – 58 T)

Tentative Specification for Factory-Made Wrought Carbon Steel and Alloy Steel Welding Fittings of Seamless or Welded Construction for Low-Temperature Service (A 420 – 58 T)

Revision.—There is now specified as a result of the revision an elapsed time of 5 sec in transferring specimens from the cooling device until broken in the low-temperature impact test. Some additional details in Specification A 320 required modification so as to bring these specifications completely in line with the intent of the Methods and Definitions for Mechanical Testing of Steel Products (A 370). A further change in Specification A 352 provides a clarification and extension of the present requirements for magnetic particle testing.

Tentative Specification for Carbon and Alloy Steel Forgings for Turbine Generator Rotors and Shafts (A 292 – 58 T)

Tentative Specification for Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts (A 293 – 58 T)

Revision.—Table III was revised to include new elongation and reduction of area values, and additional information on transition temperatures and impact requirements.

Tentative Specification for Factory-Made Wrought Austenitic Steel Welding Fittings (A 403 – 58a T)

Revision.—A new Section 4 on Chemical Composition has been added.

Specification for Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service (A 216 – 58 T)

Specification for Alloy-Steel Castings for Pressure-Containing Parts Suitable for High-Temperature Service (A 217 – 58 T)

Specification for Ferritic and Austenitic Steel Castings for High-Temperature Service (A 351 – 58 T)

Specification for Alloy-Steel Castings Specially Heat Treated for Pressure-Containing Parts Suitable for High-Temperature Service (A 389 – 57 T)

Revision.—The requirements for magnetic particle testing were clarified and extended.

Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service (A 376 – 56 T)

Specification for Austenitic Steel Forged and Bored Pipe for High-Temperature Service (A 430 – 58 T)

Revision.—At the request of the ASME Boiler and Pressure Vessel Committee, there has been included a series of austenitic steels with specified minimum and maximum carbon content, and in the solution treated condition specifically for elevated temperature application. Specification A 376 was further revised as regards the required tensile strength for grade TP 304 pipe 8 in. and larger in nominal diameter, and in schedules 140 and heavier.

Standard Specifications for Heat-Treated Carbon Steel Bolting Material (A 261 – 56)

Withdrawal.—This specification was withdrawn since limited quantities of carbon-steel bolting are used at elevated temperatures, and material furnished to the Specification for Quenched-and-Tempered Steel Bolts and Studs with Suitable Nuts and Plain Hardened Washers (A 325) is suitable for this purpose.

Non-Ferrous Metals and Alloys

Tentative Specifications for Titanium and Titanium Alloy Bars and Billet (B 348 – 59 T)

New Tentative.—These specifications meet a long-felt need to cover the manufacture and purchase of commercial titanium and titanium alloy bars and billet.

Thermal Insulating Materials

Tentative Method of Test for Mean Specific Heat of Thermal Insulation (C 351 – 54 T)

Revision.—The use of this method over the past five years has pointed up various needed changes which have now been made.

Electrical Insulating Liquids and Gases

Standard Method of Testing Askarels (D 901 – 56)

Tentative Revision.—There is provided by the tentative revision a means of detecting presence of water in askarels not revealed by electrical tests, and thereby indicating needed corrections of operating conditions when changes in water content of askarels in service are discovered.

Tentative Method of Test for Scavenger Content of Askarels (D 1701 – 59 T)

New Tentative.—These methods apply to transformer askarels containing an additive, either tin tetraphenyl or phenoxypropene oxide, as a scavenger for arc-formed gases. Separate methods specific for each scavenger are provided. Measurement of scavenger content will indicate the amount of protection available against arc-formed gases and permit estimation of the amount of makeup additive required.

Tentative Method of Test for Visual Examination of Used Askarels in the Field (D 1702 – 59 T)

New Tentative.—This method of visual examination is applicable to askarels that

(*Continued on page 46*)

An In-Place Strength Test For Low-Density Concrete *

By IRWIN A. BENJAMIN and GEORGE D. RATLIFF, JR.

THIS paper describes a test developed by the authors during the past year. A nondestructive test was needed for winter concreting studies so that strength measurements might be taken repeatedly on specimens subjected to cycles of freezing and thawing.

The test procedure described is a modification of ASTM Method C 403–57 T,[1] which measures the rate of hardening of mortar sieved out of ordinary structural grade concrete. The test, which is conducted by penetrating the mortar with a Proctor resistance needle, has been modified to measure compressive strength for low-density concrete (less than 40 lb per cu ft, oven-dry density).

The investigation included a comparison of the penetration readings for different needle sizes and the development of curves for eliminating the needle-size effect. The depth of penetration was also studied to determine the optimum depth for the strength test. The human element in running the test was evaluated by employing five different operators. The variability of the readings was compared to that of the cube compression tests on the same material.

Results of the Proctor penetration resistance test were calibrated against the cube compression tests to develop a conversion factor.

Test Equipment

The Proctor penetration resistance apparatus used in this test consists of a plunger fitted to receive interchangeable needles at the lower end. Its length is 29 in., its weight 4 lb. Needles range in size from $\frac{1}{40}$ sq in. to 1 sq in. bearing area. The apparatus has a spring stock with 1-lb graduations accurate to 1 lb and graduated from 10 to 130 lb. The needles used in this work were scribed with a line around their circumference $\frac{1}{4}$ in. from the bearing face.

A pocket version is also available. The small Proctor apparatus has a fixed needle of $\frac{1}{20}$ sq in. The small instruments are accurate in the range of 3 to 16 lb. They are, however, calibrated with a scale used for soil bearing measurements, which must be multiplied by a constant to obtain the correct readings in pounds.

Test Procedure

The procedure was carried out in accordance with following instructions:

Insert a needle of appropriate size, depending upon the state of hardening of the concrete, in the Proctor penetration resistance apparatus. The needles should be scribed $\frac{1}{4}$ in. from the bearing face in order to gage the depth of penetration. Gradually and uniformly apply a vertical force downward on the apparatus until the needle penetrates the concrete to a depth of $\frac{1}{4} \pm \frac{1}{16}$ in. The time required to penetrate shall be approximately 5 sec. Record the force required. Make a minimum of five penetrations. The penetration resistance in pounds per square inch is calculated by dividing the Proctor reading by the cross-sectional area of the needle. The $\frac{1}{20}$-sq in. needle is recommended for ordinary strength measurements. The larger needles are useful only when measuring the strength gain of "green" concrete.

Test Variables

Size of Proctor Needle

Since there is considerable overlapping of the ranges covered by the various needle sizes, it was possible to compare results from different needle sizes. Figure 1 shows the relationship, on the same concrete specimen, between the penetration resistance of a $\frac{1}{20}$-sq in. and a $\frac{1}{10}$-sq in. needle. The penetration resistance obtained with the $\frac{1}{20}$-sq in. needle is 22 per cent higher than that obtained with the $\frac{1}{10}$-sq in. needle. Comparable graphs for the other needle sizes were drawn to develop the family of curves shown in Fig. 2. These curves, the results of 160 comparative tests, adjust the penetration resistance obtained from any needle size to that of an arbitrary standard needle size, in this case the $\frac{1}{20}$-sq in. needle. As indicated in Fig. 1, these curves are valid for vermiculite, perlite, and foam types of low-density concrete.

Depth of Penetration

As might be expected, penetration force increases with depth of penetration. The relationship is not linear, however, and as the penetration depth is increased, the increase in the required force diminishes. Figure 3 shows a large number of penetrations made in a single slab using the $\frac{1}{20}$-sq in. needle. From this graph, it is apparent that penetrations greater than $\frac{3}{4}$ in. require only slight increases in the penetration force. A $\frac{1}{4}$ in. depth of penetration was selected as the optimum depth for the strength test. The graph in Fig. 3 shows that the use of a greater depth might be desirable to minimize errors in the resistance readings due to variations in the measured depth. However, a deeper penetration was not chosen since it requires more manual effort; introduces more side friction on the needle, thus requiring greater

I. A. BENJAMIN, Director of Research, Granco Steel Products Co., St. Louis, Mo., joined the Research Department in 1951. During the last five years, he has been in charge of development work on the use of light-gage steel products for use with low-density and structural grade concretes.

G. D. RATLIFF has been associated with the Research Department of Granco Steel Products Co., St. Louis, Mo., since 1957. He has been investigating winter concreting with low-density concrete and testing both low-and normal-density concrete slabs incorporating light-gage steel elements for reinforcing. Previously, he was a structural engineer for the Corps of Engineers at the Engineer Research and Development Laboratory, Fort Belvoir, Va.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author or authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Tentative Method of Test for Rate of Hardening of Mortars Sieved from Concrete Mixtures by Proctor Penetration Resistance Needles (C 403 – 57 T), 1958 Book of ASTM Standards, Part 4, p. 712.

* Presented at the Sixty-second Annual Meeting of the Society, June 21–26, 1959.

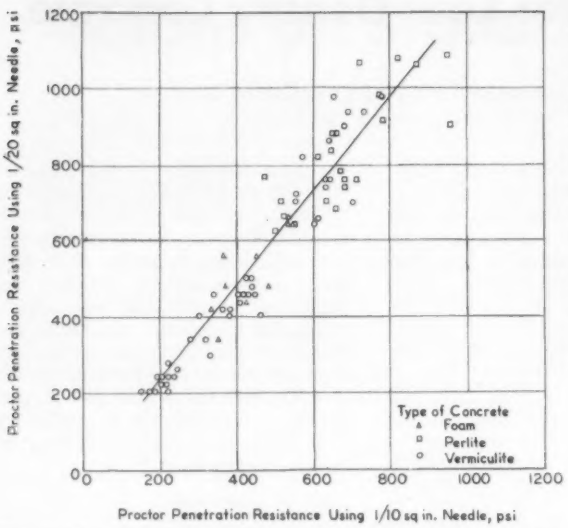
Proctor Penetration Resistance Using 1/20 sq in. Needle, psi
Proctor Penetration Resistance Using 1/10 sq in. Needle, psi
Type of Concrete
Foam
Perlite
Vermiculite

Fig. 1.—Comparison of Proctor penetration resistance for two different needle sizes.

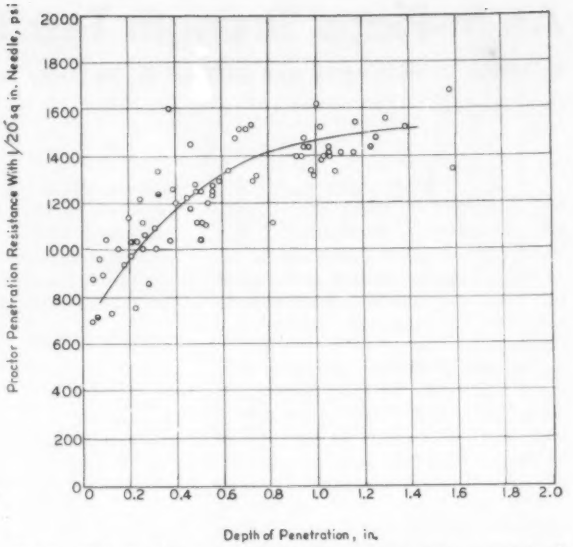

Fig. 3.—Relation between Proctor penetration resistance and depth of penetration.

alignment control; and finally, a deeper penetration is more likely to hit reinforcing rods sometimes used in lightweight concrete slabs.

Surface Condition

Readings were compared on surfaces with a wood float finish against those sanded smooth. The smoothness of the top surface had no effect on the test results. The depth of penetration can be adequately judged using the mark scribed on the needle, regardless of the surface roughness.

Reproducibility

The Proctor apparatus requires manual load application and alignment as contrasted to mechanized loading and alignment with testing machines. To investigate the reproducibility between individual operators, the same slab was tested by five different operators. The results, using procedure previously described, are given in Table I. Operators C, D, and E were experienced while A and B had had less than 5 min instruction. It was found, by applying the statistical F test, that the difference between operators was not significant. The mean coefficient of variation for the results of the five operators was 4.3 per cent.

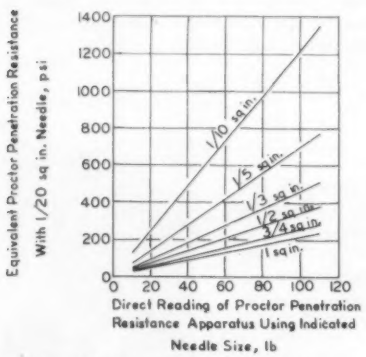
Equivalent Proctor Penetration Resistance With 1/20 sq in. Needle, psi
1/10 sq in.
1/5 sq in.
1/3 sq in.
1/2 sq in.
3/4 sq in.
1 sq in.
Direct Reading of Proctor Penetration Resistance Apparatus Using Indicated Needle Size, lb

Fig. 2.—Needle-size correction factors.

Variability

The best measure of the variability of the results of a test is given by the coefficient of variation of the test data. For the individual cube tests, shown on the calibration curve of Fig. 4, the mean coefficient of variation was 7.3 per cent. For the Proctor readings on the same group of slabs, the mean coefficient of variation was 4.7 per cent. This comparison shows that the variability of the Proctor test compares favorably with that of the cube test.

Calibration of Results

The compression strength of a 2-in. cube was chosen for calibration because the cubes could be cut from the same slab that was used for the Proctor penetrations, thus assuring identical curing conditions. Generally, the test slabs were squares 12 in. on a side and 2 in. thick, cast in forms having wooden sides and steel bottoms which were oiled before using. One half of the slab was used for Proctor penetration tests and the other half was cut into cubes. The cubes were cut in a miter box with a carpenter's crosscut saw and then sanded to the required dimensions on a power sander. They were capped with Celotex pads $\frac{1}{2}$ in. thick top and bottom and then tested in a calibrated testing machine.

Figure 4 shows the straight-line relationship between cube and penetration tests. The cube strength is equal to 0.31 times the Proctor penetration resistance in psi. Each point on the calibration curve represents the average of at least five cube tests and five penetrations. All of the concrete for this relationship was the vermiculite type incorporating neutralized vinsol resin as an air entraining agent.

TABLE I.—RESULTS OF PROCTOR PENETRATION RESISTANCE TEST OF A VERMICULITE SLAB WITH $\frac{1}{20}$-SQ IN. NEEDLE.

Operator	Average of Five Readings, lb	Estimated Standard Deviation	Coefficient of Variation, per cent
A.....	43.0	2.4	0.056
B.....	43.2	1.9	0.044
C.....	44.0	1.3	0.030
D.....	43.2	1.6	0.037
E.....	46.0	2.3	0.050

The specimens shown on the calibration curve, Fig. 4, represent a wide range of densities and curing conditions, as given in Table II.

Applications of Test

The test has been used in the Granco Laboratory for various purposes during the past year. It has been useful for repeated testing of small specimens. The test has proved to be simple for an inexperienced operator to use and gives satisfactory results in a short time. Since it is an in-place, nondestructive test, savings are realized because duplicate specimens do not have t be cast or cut from larger specimens.

A typical use is shown in Fig. 5, where the effect of early freezing on low-density concrete is plotted. In this test, one slab was air cured inside under laboratory conditions while the other

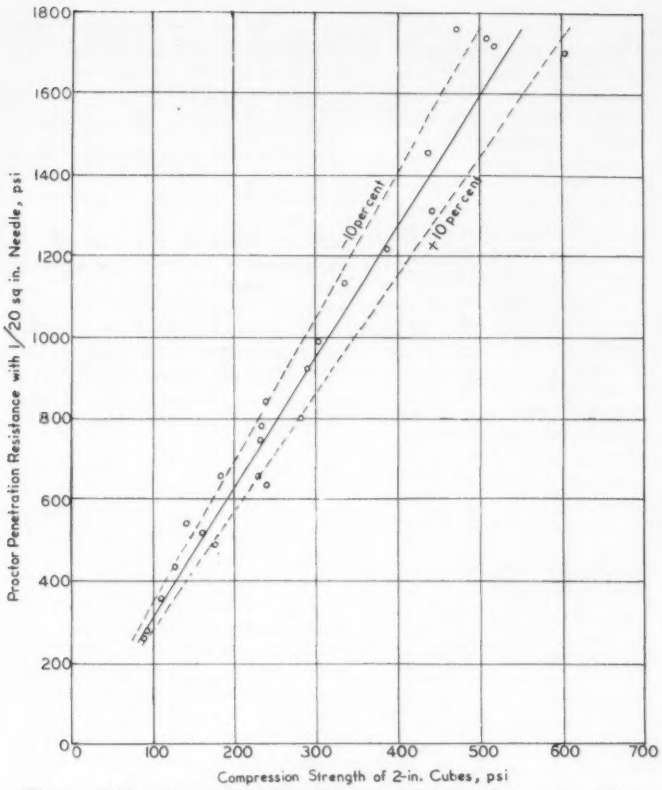

Fig. 4.—Calibration curve of Proctor penetration resistance *versus* cube strength for vermiculite concrete.

TABLE II.—TEST CONDITIONS FOR SPECIMENS PLOTTED IN FIG. 4.

		Age, days		
		0 to 7	14	Over 21
Moisture condition	Wet	...	3	...
	Air dried	3	7	1
	Oven dried	...	6	4
Density, oven-dry condition, lb per cu ft	21	...	2	...
	27 to 29	3	7	3
	34	...	1	...
	37 to 39	...	6	2

was placed outside where the temperature was 34 F and falling. The outside specimen reached freezing temperature in 4.5 hr and was subsequently subjected to numerous cycles of freezing and thawing. The strength of the exposed slab was measured and compared with the strength of the laboratory slab using the Proctor penetration test to determine the equivalent cube strength.

The Proctor test may be used as an acceptance test for low-density roof slabs. Early age strength measurements of the low-density concrete may be taken on the roof as an estimate of the ultimate strength. The rate of hardening must be considered in the light of prevailing temperatures, type of curing, and type of cement in order to estimate the ultimate strength of the slab.

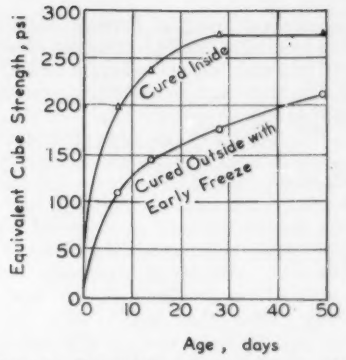

Fig. 5.—Effect of early freezing on air-cured low-density concrete.

Conclusions

The Proctor penetration resistance test can be used as a reliable measure of low-density concrete strength. The average of five $\frac{1}{4}$-in. penetrations with the $\frac{1}{20}$-sq in. needle is recommended. The concrete may be tested at any age from a minimum of about 6 hr and may be tested in place without removing concrete specimens or destorying the slab.

In the development of the strength test it was established that for the low-density concretes:

1. Penetration strength is directly proportional to compressive strength for specimens tested under a wide range of density and curing conditions.
2. Various size Proctor resistance needles cannot be used interchangeably as suggested in the ASTM test, unless correction factors are used.
3. The depth of penetration does not have to be controlled closely.
4. The coefficient of variation for penetration strength measurements is less than that for the cube compression strength measurements.
5. There is no significant difference in the results obtained from different operators.
6. The test is suitable for in-place strength measurements in the field or in the laboratory.

A calibration curve of Proctor strength *versus* cube strength is needed for perlite and foam similar to the one for vermiculite, Fig. 4. The limited data obtained so far indicate that the curve may be similar to Fig. 4 but with different proportionality constant.

DISCUSSION

MR. MORTON SHERMAN:[1] (*presented in written form*)—The Granco Steel Products Co. and the authors are to be complimented for the interest shown in the technology of insulating concrete. Since steel products are their primary interest, and concrete occupies a secondary role, the great deal of work involved in their study is especially noteworthy.

As with every complex problem, and especially in the case of research on concrete under job conditions, the over-control or limited control of variables during testing, and the analysis of the results of such tests, often results in controversy. Such controversy is a healthy condition and indicates that technologists are continually striving for

[1] Chemical Engineer, Zonolite Company Laboratory, Evanston, Ill.

maximum correlation between theory and fact. This is the pattern of scientific evolution which has been successful in the past and shows every sign of continuing.

The authors have presented data which indicate that the penetration or indentation resistance of a homogeneous insulating concrete is proportional to its compressive strength as measured on 2-in. cube specimens. The ratio of measured indentation resistance to measured compressive strength is always greater than unity. This proportionality factor is a variable and is dependent upon the bearing area, side contact area, and depth of penetration of the testing element. In the range of strengths tested, it is not affected by the type of concrete, as implied in Fig. 1, of the paper. (This implication was not confirmed in conclusion No. 6, which indicated that individual calibration curves may be necessary for the three commonly used types of insulating concrete.)

Our own work at the Evanston laboratory of the Zonolite Co. is in essential agreement with the above results. However, we would like to express some reservations as to the accuracy and dependability of interpretations that might result from data obtained with Proctor penetration needles when testing insulating concretes that have been exposed to unusual and abnormal curing circumstances, such as severe freezing conditions. Strength retardation effects of rapid and severe freezing do not occur uniformly throughout the cross-section of an insulating concrete slab so exposed, because of the inherently high insulating ability of the material itself.

Retardation effects are most severe at the exposed top surface and tend to become less severe with increased concrete thickness. That is, at any one time shortly after such exposure, a strength gradient of unknown proportions will exist in the concrete. The magnitude of this gradient will be dependent upon the severity of the exposure conditions. Obviously, a wide range of such gradients could be obtained, and how these gradients alter the factor of proportionality is still not clear. To apply the factors obtained under homogeneous conditions to nonhomogeneous materials is contrary to fundamental scientific practices, and the result of such a practice can only be considered a rough approximation at best.

Insulating concrete, like dense structural concrete, requires both heat and water to hydrate properly. Situations which remove heat from the system tend to retard strength gain until such time as heat is reapplied to the system. Conditions which prematurely remove moisture from the system can effect a loss of integrity in the affected portion of the concrete, due to the absence of the interparticle bonding present when the portland-cement network hydrates properly. Proper replacement of this lost water will usually allow hydration to proceed in the normal manner.

Experience has shown that the use of high-early strength cement, heated water, highest practical cement content, and curing membranes do most to prevent or minimize the undesirable effects due to cold weather conditions. These practices have been used in the field and have been successful. The use of nonstandard test procedures should not be advocated until such procedures have adequately demonstrated beyond question their utility and value to the concrete producer, the architect, and the customer.

It is sincerely hoped that the authors' fine efforts in the field of insulating concrete technology will encourage additional effort by cement and aggregate producers having primary interests in the field of insulating concrete to continue this work and so help to further advance the technology of insulating concrete production, installation, and quality control techniques.

MR. L. A. BARRON[2]—I would like to caution against the improper use of the term "vermiculite" instead of "vermiculite concrete," such as is shown in the heading of Table I of the paper. It is a common error, that of referring to the concrete by naming the dominant aggregate, but such use can lead to confused interpretation by the perfunctory reader. Vermiculite aggregate has been commercially used with many binders, both organic and inorganic, such as gypsum, sodium silicate, plastics, etc. An editorial change in this heading would be in order.

It is suggested that the reader confine the discussed test method to the limits outlined by the author and not "read into" the text a technique for evaluating other operations or other characteristics of these concretes.

The authors are to be honestly congratulated for their work in a field apart from their dominant interest, steel. It is to be hoped that continuing work will document the possibility as to whether or not this test method can be used as a dependable tool.

MR. WILLIAM H. KUENNING.[3]—Were any tests run on cellular concrete and if so, did they show a still different type of correlation between the Proctor needle and the regular tube test?

MR. I. A. BENJAMIN, (*author*)—We did run some tests on cellular type concrete to develop the needle size correction factors shown in Fig. 2. However, we did not run what we felt were enough tests to establish the calibration curve. The preliminary tests indicated that the calibration factor would again be about 0.3, comparable to that of the vermiculite concrete.

(*Author's closure*) The discussions are welcome additions to the paper. Mr. Sherman's interpretation of the effect of the type of concrete is incorrect. The needle-size corrections shown in Fig. 2 were developed from tests on foam, perlite, and vermiculite concretes and are equally applicable to all three types. The calibration curve, the ratio of cube strength to penetration resistance, must be developed individually for each concrete type. The curve shown in Fig. 4 indicates a 0.31 ratio of cube strength to Proctor penetration resistance. A similar curve (not shown in this paper) developed for perlite concrete indicates a 0.20 ratio of cube strength to Proctor penetration resistance.

Mr. Sherman expressed reservations on the accuracy of data obtained by the Proctor penetration test when the concrete is subject to freezing conditions. Since freezing effects are most severe on the top surface, a strength gradient exists through the depth of the concrete. The test procedure was specifically developed to measure this gradient since no other procedure was available. We have developed considerable data on strength gradients in thin concrete slabs frozen at an early age by comparing the Proctor resistance at $\frac{1}{16}$-in., $\frac{1}{4}$-in., and 1-in. depths with a control specimen taken from the same batch of concrete and wet-cured at 70 F.

The purpose of the paper was to suggest the possibility of a new strength test for low-density concrete in the hope that other laboratories would attempt to further evaluate its possibilities. Confirming data on the reproducibility and calibration curves for the many other low-density concretes would be most helpful in establishing the usefulness of the test procedure.

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[3] Development Department, Portland Cement Assn., Skokie, Ill.

The Effect of Brick Facial Texture Upon the Initial Rate of Absorption

By P. T. HODGINS

Researchers in brick masonry are cautioned about the pickup of capillary moisture by specially textured ends and faces of some bricks, when the ASTM test for initial rate of absorption[1] is performed. This moisture may prevent a true evaluation of the characteristics of such bricks, particularly when it forms a large proportion of the total moisture gained in the initial rate of absorption test. The extra moisture may also lead to confusion of the results of research work in which close control of absorption characteristics is important.

DURING a recent brickwork study by the Division of Building Research of the National Research Council of Canada, it was noticed that the measured values of the initial rate of absorption (IRA) of certain types of bricks had been affected by the face and end textures of the bricks; it was believed that this phenomenon should be brought to the attention of brick masonry research workers.

In ASTM Test Method C 67 – 57, the bricks are placed with a bedding surface immersed in ⅛ in. of water in a reservoir; the amount of water picked up by the brick in 1 min is determined by weighing. Since bricks are of varying dimensions, the value thus obtained is corrected mathematically to give the IRA in terms of a standard bedding surface area of contact, taken as 30 sq in. Therefore the IRA of a brick is expressed as the number of grams of water absorbed in 1 min on a 30-sq in. area.

When bricks with textured ends and faces were tested for IRA, columns of water could be seen in some cases moving up the surfaces, within the capillary passages of the textures. This water was clearly visible and differed from the absorbed moisture which often causes a general darkening of the faces of absorbent bricks during the IRA test. Indeed, the columns of water were observed to rise and fall with any slight rippling of the water surrounding the bricks in the reservoir.

The implication that the results of the IRA test might be invalidated for some purposes by the weight of water attracted and held by the facial capillarity prompted a further investigation of the phenomenon. In the author's opinion, no analogous pickup of water from a mortar ever occurs in practice, unless the mortar has such very poor water retentivity and high water content as to result in the heavy bleeding that would be required to feed the water columns of the brick faces.

Another investigator(1)[2] has reported measurements of small percentages of facial moisture drawn from mortar by textured (chiefly sanded) bricks generally having much finer capillary passages than those tested in the present investigation. These measurements required the use of a Kaydel moisture-tester rather than visual observations, however, and extended over long periods of brick-mortar contact time in comparison to the 60 sec duration of the IRA test. The minor amounts of facial water noted even under those conditions lend weight to the conviction that the large facial water pickup in the IRA test has no counterpart when bricks and mortar are combined.

Bricks Studied

In order to study the phenomenon of facial capillarity, 72 bricks of several textural varieties were obtained from three Canadian plants, the products of each plant being represented by one smooth-faced and two textured styles of brick. All the bricks were of the clay-shale, stiff-mud extruded type, and, for aesthetic reasons, all the textured ones had been roughened on the ends and one face as an integral part of their manufacture. This was done by passing the newly extruded bricks through scraping, scratching, or cutting processes, sometimes followed by a light rolling which caused the scrapings to adhere to the bricks. Some of the resulting textures were similar to those described as "matt face—horizontal markings," "rug," and "scored face—vertical markings" shown in plates 3, 5, and 7 of Plummer and Reardon's "Principles of Brick Engineering" (2). Two other textures were likened to tweed and to tapestry by their manufacturers.

Procedure

All the bricks were numbered and measured, then washed and oven-dried above 110 C for at least 72 hr, cooled, and tested for IRA by the standard ASTM method. Next, using a rotary diamond saw, the two textured ends and face of each brick (the two ends and one face of the smooth-faced bricks) were removed with the least possible disturbance to the bedding surfaces. Efforts were made to keep all the slabs cut from the bricks close to a uniform ⅛ in. in thickness. Finally, the bricks were washed, dried, cooled, remeasured and retested for IRA.

The IRA values of the bricks before and after the cutting could then be compared; since all the bricks had been reduced to a common condition, that is, with one smooth "die-skin" (back) vertical surface and three sawed ones, the effects of the various surface textures could thus be ascertained.

In Table I the products of the three

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[1] Methods of Sampling and Testing Brick, 1958 Book of ASTM Standards, Part 5, p. 59.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.

Brick			Initial Rate of Absorption, g per min per 30 sq in. area (IRA)		Change in IRA Resulting from Treatment	
Plant	Style	No.	Before Treatment	After Treatment	Individual	Group Average
A	s	1	29.1	29.8	+ 0.7	+0.6
		2	19.6	21.2	+ 1.6	
		3	20.8	22.0	+ 1.2	
		4	20.7	21.0	+ 0.3	
		5	17.3	18.3	+ 1.0	
		6	20.3	19.1	− 1.2	
A	a	1	64.1	60.2	− 3.9	−4.7
		2	65.9	63.4	− 2.5	
		3	81.4	74.7	− 6.7	
		4	60.5	56.0	− 4.5	
		5	59.1	52.8	− 6.3	
		6	66.5	62.0	− 4.5	
A	b	1	39.6	28.9	−10.7	−3.6
		2	44.0	40.8	− 3.2	
		3	45.0	42.6	− 2.4	
		4	45.2	42.5	− 2.7	
		6	48.5	47.0	− 1.5	
		6	44.5	43.2	− 1.3	
B	s	1	13.7	13.0	− 0.7	−0.1
		2	6.7	6.7	0.0	
		3	10.7	10.85	+ 0.15	
		4	10.4	10.8	+ 0.4	
		5	8.8	8.9	+ 0.1	
		6	9.8	9.15	− 0.65	
B	c	1	5.6	5.1	− 0.5	−1.5
		2	3.9	3.3	− 0.6	
		3	6.2	4.85	− 1.35	
		4	6.4	4.1	− 2.3	
		5	6.0	4.5	− 1.5	
		6	6.0	3.3	− 2.7	
B	d	1	10.8	11.65	+ 0.85	−0.4
		2	9.5	9.0	− 0.5	
		3	11.1	9.7	− 1.4	
		4	This specimen discarded because of error			
		5	11.4	10.95	− 0.45	
		6	9.5	8.9	− 0.6	
C	s	1	1.8	1.2	− 0.6	−0.6
		2	2.1	1.35	− 0.75	
		3	1.5	0.85	− 0.65	
		4	2.6	0.9	− 1.7	
		5	1.8	1.2	− 0.6	
		6	1.8	2.4	+ 0.6	
C	e	1	2.25	3.5	+ 1.25	+0.6
		2	1.1	1.1	0.0	
		3	1.2	2.5	+ 1.3	
		4	1.2	1.4	+ 0.2	
		5	1.1	1.6	+ 0.5	
		6	0.9	1.3	+ 0.4	
C	f	1	5.8	0.6	− 5.2	−3.7
		2	6.1	1.0	− 5.1	
		3	3.6	0.5	− 3.1	
		4	3.6	1.0	− 2.6	
		5	4.7	0.5	− 4.2	
		6	3.15	1.0	− 2.15	

manufacturing plants are designated by the letters A, B, and C. Smooth-faced bricks from all plants are given the additional letter s while those of the various specially textured styles, of which no two were entirely alike, are given letters a to f. (These textures will not be further defined because of possible attempts to forecast facial capillarity without testing.) Each group of bricks denoted by a combination of one large and one small letter in this way contains bricks numbered 1 to 6.

Observations

In Table I, bricks that decreased in IRA value as a result of the removal of their textured ends and faces must have shown facial capillary attraction for water in their original condition since other similarly treated bricks did not show the same IRA decreases.

The results show that several of the rough facial textures had a strong attraction for water, an attraction which was apparently not shared by the smooth faces and some other textures. The rough textures designated Aa, Ab. Cf, and, to a lesser extent, Bc all picked up facial water since their IRA values decreased upon removal of the ends and faces. It is significant that only in these cases could columns of facial water be seen progressing upward in the capillary passages of the brick faces and ends before the cutting process.

The bricks of textural styles Bd and Ce, although roughened, did not show any great tendency to pick up extra water on the ends and faces. The brick faces of Ce texture, in fact, seem to have repelled moisture to some extent, as the increased initial rate of absorption values measured after the cutting treatment suggest. These faces did not pick up any visible facial water and probably were too dense to be permeable to ordinary absorption. The Ce texture consisted of discontinuous surface markings with intervals of smooth spots; the markings failed in some places to approach the bedding surfaces (and hence the reservoir water). Thornton(1) has already observed that smooth areas on a roughened brick surface tend to cut off facial capillary rise.

Conclusions

It is improbable that errors in the order of 4 g of IRA in 50 or 60 g, as typified in the results for the Aa bricks in Table I, are important to most masonry research programs. In the case of low IRA bricks such as those denoted as Cf in Table I, however, it is very significant that 4 g of facial water may be picked up on a brick of 1 g "true" IRA. There is no evidence that greater errors may not be encountered with other bricks and textures; nor is there any reason to suspect that an IRA range exists within reasonable limits where the phenomenon of facial capillarity may not occur. It is suggested, therefore, that researchers consider these effects and their possible bearing upon brick masonry research programs and, in order to avoid confusion, consider restricting themselves to the use of smooth-faced bricks within the laboratory whenever close control of IRA is essential.

References

(1) John C. Thornton, "Relation Between Bond and the Surface Physics of Masonry Units," *Journal*, Am. Ceramic Soc., Vol. 36, No. 4, April, 1953, p. 105.

(2) Harry C. Plummer and Leslie J. Reardon, "Principles of Brick Engineering," *Handbook of Design*, Structural Clay Products Inst., Washington, D. C. (1943).

Thermal Insulation Measurements on Textiles—A Comparison of Two Methods

By PAUL WING and C. J. MONEGO

In evaluating many textile materials for use in garments and tents, it is necessary to determine their insulating properties. The test method adopted by the Quartermaster Corps and generally referred to as the "guarded hot plate" is similar to the method developed by the National Bureau of Standards. While the guarded hot plate procedure is currently regarded as the best available, the initial cost of its installation, the training necessary to maintain and operate the equipment, and the time required for each test have prevented its general use by laboratories in the textile industry.

This study was prompted by the need to measure thermal insulation by an alternate method that would be more readily available to most textile laboratories.

An interlaboratory study of methods of evaluating insulation conducted under the auspices of the ASTM indicated the existence of a correlation between data obtained from the guarded hot plate and from the Cenco-Fitch apparatus. Since the Cenco-Fitch instrument is inexpensive, easily operated, and has a relatively short test period, this investigation undertook to determine the range of applicability of this relationship and to compare the two instruments available in the textile laboratories of the Quartermaster Research Engineering Command. It has achieved a quantitative correlation over a wide thickness range and with different types of fabrics.

Two instruments are in use at the present time for measuring thermal insulation of fabrics—the Guarded Ring Hot Plate[1,2] and the Cenco-Fitch apparatus. The hot plate has enjoyed a position of preeminence for some time, undoubtedly due to its having been used by the Bureau of Standards and most Government laboratories. It was thought by Cleveland (1),[3] who originally set up the hot plate system in essentially its present form, that this method best simulated actual use conditions. His apparatus was a further improvement on the equipment of Sales, which was used by the Bureau of Standards during the 1920's. However, the hot plate setup is complicated and cumbersome in practice and does not commend itself to industry or to the smaller laboratories. Yet the Cenco-Fitch, which is quite rugged, inexpensive and fast, is somewhat neglected as a test instrument. Some apparent reasons for this neglect are outlined below.

Until the present time, there have existed no real criteria as to the range of applicability and reliability of either instrument used for measuring dry fabric heat transmission characteristics. Furthermore, it has never been reported whether or not a quantitative correlation exists between data, secured on the two instruments. Consequently, a certain amount of confusion has existed about the significance of data from one instrument when presented to an individual familiar only with data from the other instrument. It is apparent, also, that because of the lack of reported correlation there is a natural reluctance to put the Cenco-Fitch data on a par with the data from such an established method as the hot plate.

The purpose of the present paper is to establish the range of usefulness of both test instruments and to define the range in which a correlation between data may be set up. It must be pointed out that all results presented in this report are unique for the two instruments involved, although the same correlating technique may be applied to any other pair.

The wide variety of materials tested included poplin, duck, felt, frieze, Orlon, and several miscellaneous blends and assemblies. Their main characteristics are given in Table I.

Test Methods

Thickness Measurement

All thicknesses were measured by Schiefer's compressometer (2) at 0.01 psi after the samples had been conditioned at 70 F and 60 per cent RH for 24 hr.

Thermal Transmission Measurement

All specimens were tested first with the standard guarded ring hot plate apparatus.[2] Subsequent tests were made on the Cenco-Fitch apparatus (3).

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C. J. MONEGO, a graduate of the Philadelphia Textile Institute, has had industrial experience at the Shelton Looms and at the Forstmann Woolen Co., where, as a research technologist, he assessed the comfort properties of fabrics among his duties.

He entered government service in June 1951 to resume work on thermal transmission and other properties of materials. He is presently a Technologist at the Quartermaster Research and Development Center, U.S. Army, in Natick, Mass.

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[1] Hereafter referred to as the hot plate.

[2] ASTM Method of Test for Thermal Transmittance of Textile Fabric and Batting Between Guarded Hot-Plate and Cool Atmosphere, 1958 Book of ASTM Standards, Part 10, p. 664.

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.—CHARACTERISTICS OF SAMPLES.

Sample	Thickness, in.	Weight oz per sq yd	Density, lb per cu ft
Felt, type F-3	0.308	63.0	17.0
Blanket, Orlon	0.202	10.75	4.42
Felt, 5/64 in.	0.117	19.0	13.5
Felt, 1/16 in.	0.112	15.1	11.20
Felt, assembly of 1/16 in. and 5/64 in.	0.221	34.1	12.85
Felt, 3/16 in.	0.152	24.7	9.34
Felt, type F-11	0.330	36.3	9.14
Duck, 12.29 oz	0.063	11.75	15.50
Duck, 8½ oz	0.047	8.15	14.44
Frieze	0.254	17.25	5.64
Felt, assembly F-3 and F-11	0.600	99.30	13.80
Jacket, assembly with polyurethane	0.426	16.50	3.24
Underwear, unwashed Dynel/cotton	0.102	10.15	8.28
Underwear, washed Dynel/cotton	0.103	8.97	7.24
Underwear, unwashed wool/cotton	0.082	9.06	9.19
Underwear, washed wool/cotton	0.114	10.30	7.52
Pile, type fabric A	0.372	14.30	3.20
Pile, type Fabric B	0.363	14.40	3.31
Poplin	0.025	4.75	15.80
Felt, ½ in.	0.613	81.00	11.10

Test Procedure

Guarded Ring Hot Plate

Specimens were placed on the flat horizontal hot plate (Fig. 1) about 20 in. square in a conditioning chamber maintained at a constant temperature (±1 F) within the range of 45 to 60 F and at a relative humidity of 50 per cent (±10 per cent depending on room conditions). The surface of the hot plate was kept at 96 F (±1 F) by means of an electronic switch arrangement (Fig. 2). The electrical energy required to maintain the surface temperature as heat escapes through the fabric is subtracted from that needed when the plate is bare, the difference being used to compute the insulative effectiveness of the specimen.

The testing arrangement of this instrument corresponds to that of a man losing heat in a cold atmosphere and generating heat at the rate necessary to keep his skin at 96 F. The test measures heat loss under conditions of temperature equilibrium. Results from a different hot plate setup would probably vary somewhat from those gathered at this installation because of inherent differences in hot plate and conditioning chamber parameters. This is why the correlation referred to later must be considered unique for this particular hot plate.

At least two, and generally three or more, runs were made with each specimen and the results averaged. Except for very thin specimens, which were tested only for the sake of completeness since they were outside the range of the method, the results showed good reliability and reproducibility.

Cenco–Fitch Apparatus

Once tested on the hot plate, 4-in. diam pieces were cut from the original specimens for testing on the Cenco-Fitch apparatus (Fig. 4(*a*) and (*b*)). This apparatus measures dry thermal insulation on a somewhat different basis than the hot plate, being what might be defined as a rate-of-temperature-change measuring instrument. The 4-in. specimen was sandwiched between two circular plates, the top one maintained at a temperature of 212 F and the bottom one left thermally isolated at room temperature, initially. As heat penetrates the specimen, the bottom plate becomes warmer and, from the rate of temperature rise as measured by thermocouples, one can calculate directly the thermal resistance of the specimens.

The Cenco-Fitch apparatus used in this laboratory has been modified to permit testing under various pressures. The top plate is kept at a fixed distance from the table and the bottom plate brought up to the prescribed distance from the top plate by means of a machine screw and vernier. For this program all fabrics were tested under 0.01 psi. This pressure is arrived at by first measuring the thickness of the specimen corresponding to 0.01 psi and then setting the distance between plates accordingly.

This test measures primarily the conductive characteristics of the specimen and trapped air and minimizes insulation effects due to radiation and surface convection. In a loose sense, the Cenco-Fitch arrangement may be considered as corresponding to the situation of a man in direct contact with a solid material as he would be (for example) if he were lying down or leaning against a wall.

As opposed to the inherent individuality of the hot plate setup, the Cenco-Fitch results should be almost exactly reproducible on any other Cenco-Fitch, because the radiative and convective effects, which are so variable, are virtually nonexistent.

Test Results

The accumulated data for the various fabrics are presented in Table II. However, for the sake of clarity,

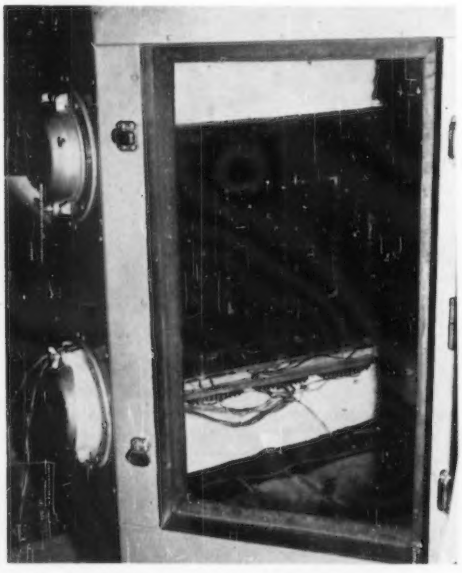


Fig. 1.—Bare hot plate in conditioning chamber.

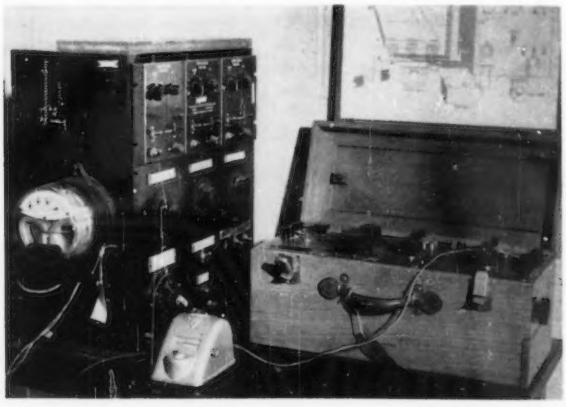


Fig. 2.—Electronic switch, potentiometer, and timer for hot plate.

dividing the thermal data into two distinct sets and considering each set individually is advantageous.

Cenco–Fitch Thermal Data

The data obtained by the Cenco-Fitch are listed under heading A of Table II. In order to organize the data into a meaningful system, Fig. 3(*a*) was prepared to show the relationship between the thickness and corresponding thermal insulation (clo) of each specimen. The clo is defined in terms of other thermal insulation units in ASTM Methods D 1518.[2] A striking characteristic becomes evident in this graph, namely, except for three specimens, all the specimens tested fell within ±10 per cent of a line having a slope $m = 3.0$. In other words, the Cenco-Fitch demonstrates that a linear relationship between thickness and insulation exists for virtually all the types of fabrics tested. That three of the specimens tested fell below the expected insulation values can be explained by examining each of the three cases individually. The specimen yielding a clo value of about 0.7 instead of the expected 0.9 was a felt with a particularly high density. Apparently, its fabric-to-trapped-air ratio was great enough to influence the insulative effect which in other fabrics is primarily determined by trapped air alone. This phenomenon will be investigated more thoroughly in a later study on felts.

The other two specimens yielding unexpectedly low insulation values of 1.41 and 1.54 clo were a combination of two felts and a low-density felt. However, in these cases the low insulation values were primarily due to the thickness of the specimens involved, which was about 0.6 in. Because of the inherent nature of the instrument involved, specimens of this thickness begin having significant heat losses from the edge of the specimen, the edge thickness being a significant fraction of the surface diameter. It has been indicated before and reaffirmed by this study that the Cenco-Fitch apparatus will measure thermal properties accurately up to a thickness of about ½ in. Thereafter, results become increasingly inaccurate because of the edge effects.

The line best approximating the insulating-thickness trend was found by averaging the clo-per-inch values of 18 of the 20 fabrics tested in this study. It is significant that only one out of the 18 fabrics, neglecting those with thicknesses greater than ½ in., had an insulating value falling outside the arbitrary limits of ±10 per cent. Consequently, it is safe to assume that the thermal resistance of fabrics whose density falls below some as yet undetermined critical value is controlled by a general relationship stated as follows: thermal resistance is a linear function of fabric thickness taken at touch pressure.

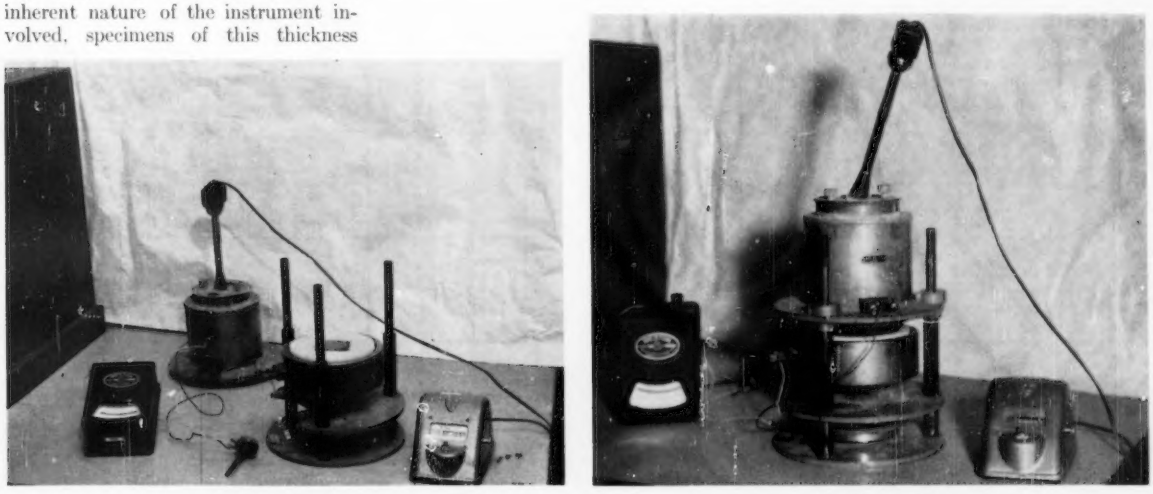
Any fabric the thermal resistance of which deviates from this linear relationship must be considered to be an exceptional one; such a fabric must have unusual constructional parameters. The felt discussed previously is an example, its density being unusually high.

It should be mentioned here that the raw data (U_1) obtained by the Cenco-Fitch have been adjusted in order to eliminate the residual resistance effect at zero thickness. It was found from previous work that this residual resistance is:

$$0.02 \frac{\text{hr deg Fahr sq ft}}{\text{Btu}},$$

TABLE II.—CORRELATION DATA.

Fabric	Thickness	A. Cenco-Fitch			B. Hot Plate		
		U_2	Clo	Clo per inch	U_2	Clo	Clo per inch
Felt, F-3	0.308	1.63	0.703	2.29	1.47	0.774	2.52
Blanket A	0.202	1.84	0.618	3.06	1.48	0.768	3.80
Felt 5/64	0.117	3.23	0.353	3.01	2.69	0.422	3.61
Felt 1/8	0.112	2.97	0.384	3.28	2.98	0.381	3.40
Felt 1/8 and 5/64	0.221	1.645	0.701	3.17	1.49	0.762	3.45
Felt 1/8	0.152	2.53	0.452	2.97	2.50	0.455	3.00
Felt, F-11	0.330	1.13	1.01	3.06	1.02	1.11	3.37
Duck, heavy	0.063	5.80	0.196	3.11	3.95	0.288	4.57
Felt 1/2	0.613	0.740	1.54	2.51	0.607	1.88	3.07
Duck, light	0.047	7.57	0.151	3.21	2.76	0.412	8.76
Pile A	0.372	1.02	1.11	2.98	0.961	1.18	3.17
Frieze	0.254	1.60	0.711	2.80	1.45	0.784	3.08
Pile B	0.363	1.09	1.05	2.89	0.961	1.18	3.25
Felt F-3 and F-11	0.600	0.807	1.41	2.35	0.577	1.97	3.28
Jacket	0.426	0.910	1.25	2.94	0.700	1.62	3.80
Dynel underwear, unwashed	0.102	4.03	0.282	2.76	5.72	0.199	1.95
Dynel underwear, washed	0.103	3.69	0.309	3.00	5.31	0.214	2.08
Standard underwear, unwashed	0.082	4.47	0.256	3.12	4.67	0.239	2.91
Standard underwear, washed	0.114	3.16	0.360	3.16	3.40	0.334	2.93
Poplin	0.025	13.20	0.087	3.48	6.95	0.163	6.52



(a) Before testing. (b) During test.

Fig. 3.—Cenco-Fitch with timer and galvanometer.

thus the correcting relationship is:

$$\frac{1}{U_2} = \frac{1}{U_1} - 0.02.$$

Consequently, the line describing the clo *versus* thickness relationship must go through the origin, as it does.

Hot Plate Thermal Data

In order to present in an organized manner the thermal data obtained by means of the hot plate, the data under heading B of Table II were plotted in Fig. 3(*b*) to show the relationship between thickness and thermal resistance for each specimen. At first glance, this plot shows no apparent linear relationship—particularly for thicknesses below 0.1 in.—between thickness and thermal insulation such as was observed from the Cenco-Fitch data. However, it is precisely in this region that the hot plate system is completely inadequate, becoming grossly insensitive, with small measurement errors being reflected as huge errors in clo. This fact is proved by the large scatter of points below 0.11 in.

Now, neglecting all points below 0.11 in. and assuming that a straight line can best describe the clo-thickness relationship for the remaining points, the average clo-per-inch value for these points was calculated and found to be 3.23 clo per in. Accordingly, a line with this slope was drawn through the origin and two auxiliary lines marking the ±20 per cent error limits were also drawn. It is evident that all points but one fall within these limits and it appears that a straight line best describes the data from the hot plate also. The one unusually low point occurring at a thickness of 0.3 in. comes from the same felt that gave a low clo value with the Cenco-Fitch.

TABLE III.—CORRELATION ERROR.

Sample	Cenco-Fitch, Experimental, Clo	Hot Plate, Experimental, Clo	Hot Plate, Predicted, Clo	$100 \times \frac{\text{Predicted} - \text{Experimental}}{\text{Experimental}}$, Error, Per Cent
Felt, F-3	0.703	0.774	0.760	−2
Blanket A	0.618	0.768	0.668	−13
Felt 5/64	0.353	0.422	0.381	−10
Felt 1/8	0.384	0.381	0.415	+11
Felt 1/8 and 5/64	0.701	0.762	0.757	−3/5
Felt 1/8	0.452	0.455	0.488	+7
Felt, F-11	1.01	1.11	1.09	−2
Pile A	1.11	1.18	1.20	+2
Frieze	0.711	0.784	0.768	−2
Pile B	1.05	1.18	1.14	−3½
Jacket	1.25	1.62	1.35	−16
Standard underwear, washed	0.360	0.334	0.389	+16

Although a wider scatter about the describing line is found for the hot plate data, ±20 per cent as compared to ±10 per cent for the Cenco-Fitch, nevertheless a definite straight line trend in the points does exist and should be considered valid. Furthermore, hot plate data obtained from sleeping bags (4) which have thicknesses in the range of 1.0 to 3.0 in., while slightly scattered, do agree substantially with what would be expected from an extrapolation of the data in this study, which further strengthens the straight line assumption.

Thus the insulation behavior of fabrics, expressed as a general relationship from Cenco-Fitch data, is essentially the same as that from data by the hot plate method. Consequently, the general linear relationship of thermal resistance with fabric thickness holds for hot plate data for thicknesses up to several inches. Again it is implicitly assumed that sample density is not unusually high and that thickness is taken at touch pressure.

As with the Cenco-Fitch, the raw data, U_1, determined by the hot plate have been corrected to eliminate the residual resistance at zero specimen thickness. This residual resistance was measured by running the hot plate bare. U_{bp}, the constant reflecting bare plate resistance, was determined by this technique, and U_2, the calculated value, was obtained making use of the relationship.

$$\frac{1}{U_2} = \frac{1}{U_1} - \frac{1}{U_{bp}}.$$

Consequently, at zero specimen thickness the plot of clo *versus* thickness must intersect the origin (clo = $1.131/U_2$).

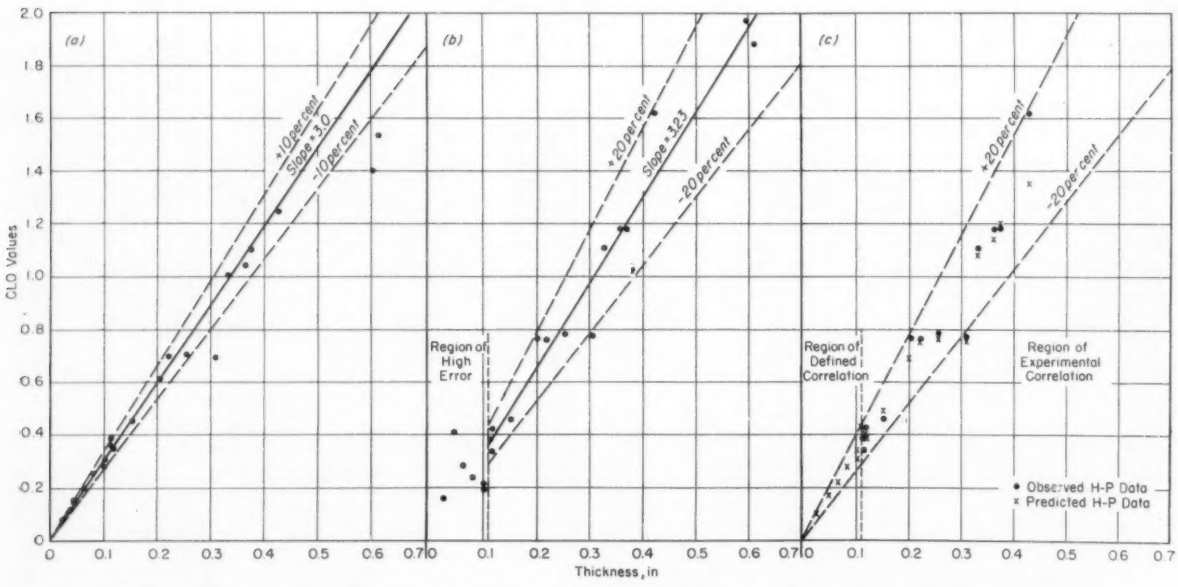


Fig. 4.—(a) Relation of thermal resistance to sample thickness using Cenco-Fitch data. (b) Relation of thermal resistance to sample thickness using Hot-plate data. (c) Plot of predicted and experimental Hot-plate data showing existence of correlation.

Correlation of Test Results

Since each method yields an essentially linear relationship between thickness and clo over a definite range, it follows that in the area of overlap of these two useful ranges a correlation should be possible.

The useful range of each instrument as mentioned previously was found to be from 0 to $\frac{1}{2}$ in. for the Cenco-Fitch and 0.11 to several inches for the hot plate. The overlap occurs from 0.11 to $\frac{1}{2}$ in. If it is desired to predict hot plate results from Cenco-Fitch data, then the relationship is.

$$\text{clo}_{HP} = \frac{\text{Slope}_{HP}}{\text{Slope}_{CF}}\text{clo}_{CF} \text{ or}$$

$$\text{clo}_{HP} = \frac{3.22}{3.00}\text{clo}_{CF}$$

which reduces to

$$\text{clo}_{HP} = 1.08\,\text{clo}_{CF} \ldots\ldots\ldots (1)$$

Stated simply, the thermal resistance of a fabric as measured by the hot plate will be 8 per cent greater than that measured by the Cenco-Fitch (for fabric thicknesses between 0.11 and $\frac{1}{2}$ in.).

This statement is derived mathematically. It is of considerable interest to see how well this correlation holds experimentally for the individual specimens since, individually considered, the correlation may be subject to huge errors even though as a correlation between the two trends it is valid.

Consequently, Table III was set up. Experimentally determined hot plate and Cenco-Fitch clo values for each sample are listed along with the predicted hot plate clo value derived from the Cenco-Fitch data and Eq 1. Subsequently, Fig. 3(*c*) was plotted with the hot plate clo values, experimental and predicted, the circles being experimental data and the crosses predicted data. Also, in Table III, the correlation error is presented to give a measure of its usefulness.

As can be seen from the graph and from the calculated error, the correlation is quite good, especially for fabrics well within the thickness limit. Near 0.11 in., the error rises as high as 16 per cent, as it does again at thicknesses approaching $\frac{1}{2}$ in. However, between the thickness of $\frac{1}{8}$ in. and 0.4 in. the error is quite small, less than 7 per cent except for one specimen that inexplicably deviates by 13 per cent at 0.2 in. The greater error, near 0.11 in., is due to the increasingly erratic behavior of the hot plate and, similarly, the error must progressively increase near $\frac{1}{2}$ in. because of the characteristics of Cenco-Fitch data at these thicknesses. In any event, a valid correlation does exist for results from the two methods with a prediction error of less than 16 per cent, the correlation being expressed by Eq 1. It seems quite justifiable to propose that the correlation can extrapolated to zero thickness. True, the hot plate cannot accurately determine insulation below 0.11 in. but, if it is arbitrarily assumed that the correlation holds to zero and neglecting the fact that this assumption cannot be checked, then the Cenco-Fitch could, in essence, predict hot plate values below 0.11 in. Actually, it is necessary only to define hot plate data below 0.11 in. to be 8 per cent greater than Cenco-Fitch data and a logical and consistent correlation system results. Consequently, it is now simply a matter of stating what has been arbitrarily defined and experimentally determined in a concise expression: The relationship $\text{clo}_{HP} = 1.08\,\text{clo}_{CF}$ is valid for fabric thicknesses up to $\frac{1}{2}$ in. with a probable error of less than 7 per cent and a maximum error less than 20 per cent where *HP* and *CF* refer to hot plate and Cenco-Fitch respectively.

Conclusions

The conclusions that are reached in the foregoing analysis can be recapitulated as follows.

1. The Cenco-Fitch data are very reliable and reproducible for fabrics in the 0 to 0.5 in. thickness range.

2. The hot plate is useful and fairly dependable for fabrics with thicknesses greater than 0.11 in.

3. A correlation accurate within ±10 per cent exists between the two sets of data for thicknesses $\frac{1}{8}$ in. to 0.4 in.

4. A correlation exists experimentally within ±20 per cent from 0.11 to $\frac{1}{2}$ in. and is extended by definition to zero thickness.

5. A clo value prediction of hot plate data, accurate within ±20 per cent for any thickness up to $\frac{1}{2}$ in., is possible when given Cenco-Fitch data.

6. The correlation expression is $\text{clo}_{HP} = 1.08\,\text{clo}_{CF}$ for thicknesses 0 to $\frac{1}{2}$ in.

7. Ordinary fabrics, when tested by the Cenco-Fitch, observe a thickness-insulation relationship to within 10 per cent for thicknesses to $\frac{1}{2}$ in. This relationship is, where thickness is in inches, clo = 3.0 × thickness.

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A Powder Explosibility Tester with Continuous Feed[1]

By W. D. BOX

A continuous system for testing the explosibility of powdered materials has been developed. The limits of concentration of powder in air within which explosions occur can be simply and repeatably determined by continuously varying the flow ratio of sample to air until the mixture ignites.

A precision of ±0.007 g sample per liter of air, at the 95 per cent confidence level, has been obtained for each of ten measurements with a powder consisting of 90 per cent aluminum and 10 per cent inert material that exploded at an average concentration of 0.307 g sample per liter of air.

Samples of aluminum, coal, sugar, and flour have been tested successfully in the new apparatus. Samples of copper and nickel, tested by the same method, did not explode in the concentration range between 0.003 and 0.353 g per liter.

THE HAZARDS involved in handling air-suspended solids are well known. Many industries handle materials in powder form which are potentially explosive. Coal, cellulose, cocoa, cornstarch, oat hulls, sulfur, sugar, and metal powders are but a few of these hazardous materials. Safe handling of these materials is a continuous problem, and experimental determination of explosive limits is of considerable importance.

At the present time most of the determinations of explosive limits have been batch test operations. Almost all the equipment described in the literature has been patterned after the Clement-Frazer design (1).[2] In the Clement-Frazer apparatus, a weighed amount of powder is dispersed by a blast of air from a calibrated bulb. The powder is blown past a heat source in an explosion chamber. Mason and Taylor (2) substituted an aluminum strip ignited by a 230-v d-c source for the arc. Griffin and Adams (3) made use of the reaction between magnesium powder and barium peroxide for their heat source. Dussen (4) and Matla (5) substituted a magnetic valve for the quick-opening mechanical air valve used in previous designs.

An apparatus similar to the Hartmann, Nagy, and Brown (6) version of the Clement-Frazer design has been used to determine the minimum explosive concentration of aluminum powder. A schematic view of this apparatus is shown in Fig. 1.

Disagreement exists on the powder concentration necessary to produce an explosion. For example, the published values of the minimum explosive concentration of aluminum powder range from 0.007 to 0.427 g per liter (7). Variables that contribute to these differences are discussed by Birchall (8), Malin, Campbell, and Mautz (9), the Table of Common Hazardous Chemicals (10), and Hartmann (11). Hartmann states that powders in the form of flat plates will explode at a lower concentration and temperature than spherical particles. He also states that the smaller its particle size the more readily a powder will explode. Some disagreement may be due to the failure of numerous investigators to state the shape or particle size of the powder tested. Disagreement of published data may also be due to nonuniformity of the powder dispersion produced by the Clement-Frazer apparatus. When the air is released, the main portion of the powder may be carried by the front of the air stream, a condition resulting in a much greater concentration of powder at the heat source than calculated. To improve the dispersion of the powder, a system has been designed and constructed that feeds powder and air continuously at known rates.

This paper describes the design of the continuous feed apparatus, the operational procedure, an evaluation of reproducibility, comparative measurements to the batch method, and possible applications.

Apparatus

The assembled apparatus, shown in Fig. 2, consists of the powder feed system, the air feed system, and the explosion chamber.

Powder Feed System

The powder feed system, shown in Fig. 3, consists of the powder hopper, feed screw, and receiver funnel. The powder hopper is a funnel shaped container in a square enclosure. The hopper is enclosed to eliminate a

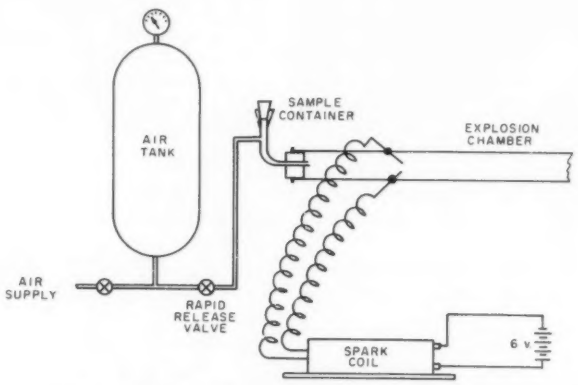

Fig. 1.—Modified Clement-Frazer explosibility tester.

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[1] This paper is based on work performed at the Oak Ridge Gaseous Diffusion Plant operated by Union Carbide Corp. for the U. S. Atomic Energy Commission.

[2] The boldface numbers in parentheses refer to the list of References appended to this paper.

WILLARD DONALD BOX received his B.S. degree in chemistry from the University of Louisville in 1952. During his schooling he was employed by the Kentucky Color and Chemical Co. in the organic color research laboratory. At present he is with Union Carbide Nuclear Co. as a group leader in the Works Laboratory at the Oak Ridge Gaseous Diffusion Plant. He has been testing various powders for explosibility over the past four years.

pressure differential between the surface of the powder bed and the effluent point. An agitator prevents the powder from packing. A $\frac{1}{2}$-in. diameter steel drill, driven by a variable-speed motor, was used as the feed screw. A bypass allowing a small flow of air from the

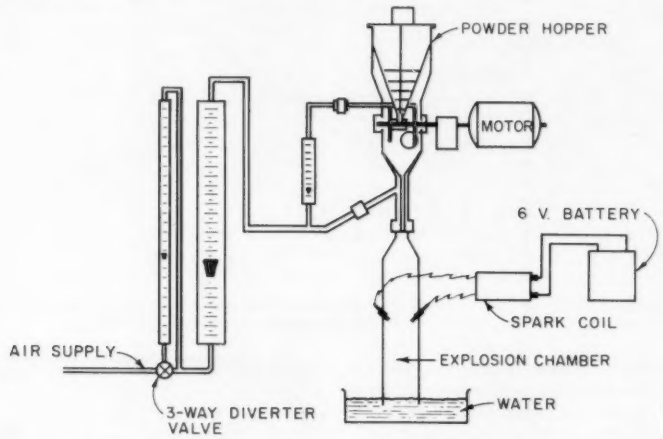

Fig. 2.—Explosibility tester with continuous powder feed.

main stream to sweep the powder from the receiver funnel and the extension of the exit tube of the receiver funnel below the air inlet were necessary to prevent clinging of the powder to the wall. The precision of the powder feed rate at any screw speed was determined by inserting a metal boat to catch the powder, collecting samples for 10 sec, and then weighing the powder. The powder feed during each 10-sec interval was constant within 6 per cent of the average value between 1 and 25 g per min. The actual irregularity in feed may be smaller since the imprecision in the time interval measurement is estimated to be ±5 per cent.

Air Feed System

The air enters through a rotameter. A small portion of it is bypassed to clean the receiver funnel as mentioned above. The area where air and powder are mixed must be completely free of surface roughness that could cause accumulation of powder.

The Explosion Chamber

The explosion chamber is a pyrex tube, $2\frac{1}{2}$ in. in diameter, flared at the top to reduce turbulence. The spark is generated by means of a Ford spark coil producing a continuous discharge at 20,000 v.

As a safety feature, a water scrubber was used at the exit of the explosion chamber to collect unexploded powder and prevent a possible explosion outside the chamber.

Operational Procedure

The various manipulations and calculations necessary to perform calibration of the apparatus, determination of the minimum explosive concentration, and change of powder-to-air ratio are as follows:

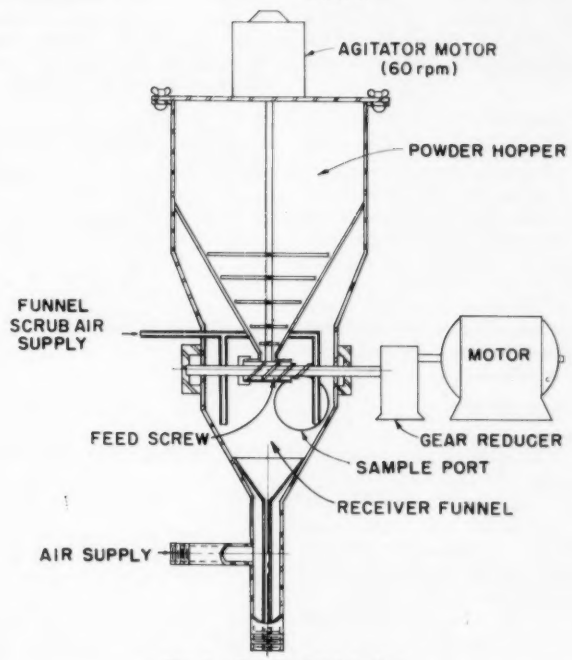

Fig. 3.—Powder feed system.

1. Loading of the apparatus:

(*a*) Place approximately 50 g of powder in the hopper.

(*b*) Position lid and agitator. Tighten wing nuts.

2. Calibration of the powder feed rate:

(*a*) Start the agitator and feed-screw motors and adjust the gear reducer until the feed rate is approximately 1 g per min.

(*b*) Open the sampling port, introduce metal boat, and collect powder for 10 sec. Collect at least three such samples.

(*c*) Weigh samples and determine average feed rate.

3. Determination of the minimum explosive concentration:

(*a*) Close sampling port and adjust air valve to a powder-to-air ratio of 0.004 g per liter.

(*b*) Ignite spark. If no explosion occurs, slowly adjust powder-to-air ratio until an explosion occurs or until a powder-to-air ratio of 0.035 g per liter is attained.

(*c*) If no explosion has occurred, shut off air and spark and continue with step 4.

4. Continuation of the test at a higher powder-to-air ratio:

(*a*) Readjust powder feed rate to approximately 10 g per min and determine actual feed rate as in steps 2(*b*) and (*c*).

(*b*) Close the sampling port and adjust air valve to a powder-to-air ratio of 0.035 g per liter.

(*c*) Ignite spark. Slowly reduce air supply until an explosion occurs or until a powder-to-air ratio of 0.353 g per liter is attained.

(*d*) Shut off air, spark, and powder feed.

5. Calculation of the minimum concentration:

$$\frac{\text{Powder feed rate, g per min}}{\text{Air flow at explosion, liter per min}} = \text{min explosive concentration, g per liter}$$

Test Results

Precision of Measurement with Aluminum Powder

To determine the precision of minimum explosive concentration values obtained with the continuous feed

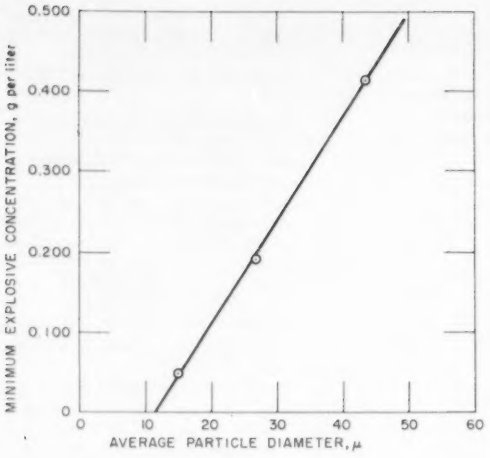

Fig. 4.—Effect of particle size on minimum explosive concentration of aluminum powder.

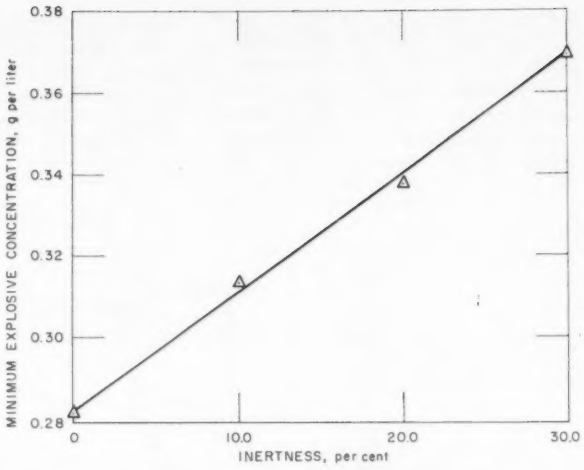

Fig. 5.—Effect of inert material on minimum explosive concentration of aluminum powder (MD 201).

apparatus, ten replicate samples of an aluminum powder mixed with 10 per cent of an inert material were tested. This mixture had a particle diameter near 35 μ. The results, presented in Table I, averaged 0.307 g of sample per liter of air. A precision of ±0.007 g of sample per liter of air per determination at the 95 per cent confidence level was attained.

Effect of Particle Size

The effect of the particle size on the minimum explosive concentration of the powder under test was investigated in order to verify Hartmann's statement (11) that the smaller the particle size the more readily a powder will explode. Aluminum powders of three different average particle diameters were tested to establish this effect on the minimum explosive concentration. Figure 4 shows Hartmann's statement to be true.

Effects of Inert Diluents

The mixing of inert materials with explosive powders is known to reduce the explosibility of these powders (12). Tests with aluminum powder were made to determine this relationship quantitatively. A plot of the percentage of inert materials present *versus* minimum explosive concentration is presented in Fig. 5. For aluminum powder, the curve is linear.

Comparative Measurements with the Clement-Frazer Method

Minimum explosive concentrations obtained by testing a typical aluminum powder with the Clement-Frazer apparatus (Fig. 1) were approximately ten times lower than those obtained by testing the same powder with the new continuous feed apparatus (0.007 *versus* 0.066 g per liter). Replicate analyses on numerous samples tested with the Clement-Frazer apparatus were inconclusive because some tests resulted in a violent explosion while in others the powder failed to explode.

Other materials tested with the continuous feed apparatus follow the same trend in that the results obtained are consistently higher than those reported by investigators who use the Clement-Frazer (batch) method. The minimum explosive concentration of coal dust was determined to be 0.186 g per liter as compared to the literature value of 0.035 g per liter, of flour 0.315 g per liter as compared to 0.059 g per liter, and of powdered sugar 0.262 g per liter as compared to 0.049 g per liter.

TABLE I.—MINIMUM EXPLOSIBILITY CONCENTRATION FOR TYPICAL ALUMINUM POWDER (MD 101) MIXED WITH 10 PER CENT INERT MATERIAL.

Test	Minimum Explosibility Concentration, g per liter
1	0.305
2	0.308
3	0.303
4	0.302
5	0.305
6	0.307
7	0.312
8	0.308
9	0.310
10	0.307
Average	0.307 ± 0.007

Discussion

The comparative data obtained by both the batch and dynamic testers support the theory that the batch test apparatus forms a nonuniform cloud with a greater concentration of powder at the front of the air stream.

When some powders are tested in the Clement-Frazer apparatus, small flashes

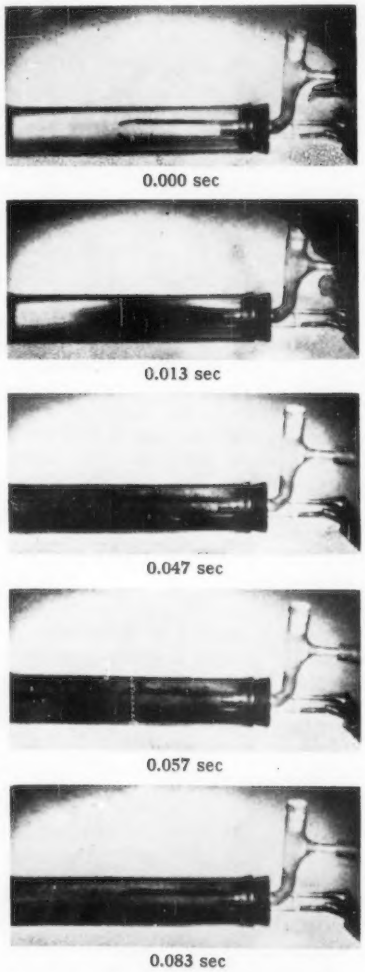

Fig. 6.—Clement-Frazer explosibility tester in operation.
Time after air release is shown.

occur in the vicinity of the spark that may or may not be duplicated in repeating the test. Therefore, results are inconclusive for the particular concentration tested. Such flashes may indicate that the explosive threshold is being approached. The five single frames in Fig. 6, taken from a 16-mm film exposed at a rate of 3000 frames per sec, show critical phases in the operation of the Clement-Frazer apparatus. The main portion of the powder passes the spark within 0.05 sec. The complete film shows that air continues to flow for 0.25 sec and thus supports the statement that the main portion of the powder may be carried by the front of the air stream.

With the new apparatus, the minimum explosive concentration can be approached slowly until a true explosion occurs. Results may be quickly confirmed by varying the air supply and approaching the explosive limit again.

The minimum explosive concentration should be determined by continuously increasing the sample-to-air ratio. The maximum explosive concentration, that is the concentration above which there is insufficient oxygen for an explosion, should be determined by continuously decreasing the sample-to-air ratio. The explosive concentration will thus be approached from the nonexplosive side; otherwise, the heat generated during the explosion may not be dissipated and may cause a sustained explosion.

The continuous powder feed apparatus could be used as an alarm system. A continuous sample of the atmosphere in a work area would be used instead of laboratory air, and a small excess of the explosive powder being handled would be continuously added to the test atmosphere. When the concentration of powder in the atmosphere of the work area rises to within the safety excess, an explosion occurs in the test apparatus and a heat-sensitive relay sounds an alarm.

Summary and Conclusions

The apparatus described in this paper forms a cloud of known composition that can be readily varied to meet the demands of specific tests. There are some data to indicate that the cloud produced is more uniformly dispersed than that produced by apparatus of the Clement-Frazer type. Further testing of the apparatus with a variety of powders is necessary to determine how much of the disagreement in reported values is due to nonuniformity of the cloud.

The apparatus under consideration is economical to construct, simple to operate, and capable of producing low-cost analyses that are precise over a wide range.

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Discussion of Paper on Effect of Specimen Taper on Determination of Elongation in the Tension Test[1]

MR. F. H. DILL[2] (*by letter*).—In the Kula and Larson paper, there are repeated references which identify round tension test specimens having slight taper from the ends to a smaller diameter at mid-gage length as "Standard ASTM" specimens. Admittedly this is a commonly used form of specimen, but it is a permitted alternate and not a standard. Reference to Methods E 8 and A 370 shows that a cylindrical specimen is the standard type. Proper recognition of what is standard and what is alternate would change the emphasis of the Kula and Larson paper from apparent criticism of an ASTM standard to defense of the standard and criticism of the permitted alternate. This seems to be a rather important change.

MR. ERIC B. KULA (*author*).—The authors would like to thank Mr. Dill for his discussion. He is correct in pointing out that a round tension specimen with a slight taper in the gage-length section is a permitted alternate and is not the standard specimen. Nevertheless, it is more common for people to use this permitted alternate than not, and the results they obtain will differ by about 15 per cent from results obtained with a cylindrical, taper-free specimen. Since some taper is desirable to ensure fracture within the gage-length section, and the exact amount of taper is in general not stated together with the results, this uncertainty as to the exact value of elongation remains. Awareness of this discrepancy is desirable.

[1] Eric B. Kula and Frank R. Larson, "Effect of Specimen Taper on Determination of Elongation in the Tension Test," ASTM BULLETIN, No. 238, May 1959, p. 58 (TP 126).

[2] Assistant to Vice-President, Engineering, American Bridge Div., Pittsburgh, Pa.

High-Stress, Low-Cycle Fatigue Properties of Notched Alloy Steel Specimens

By S. YUKAWA and J. G. McMULLIN

Two types of notched plate specimens and a notched bend-test specimen were subjected to tension-only (zero stress ratio) fatigue loading at nominal stresses of 50 per cent or more of their static strength. For all three types of specimens 10^4 load applications at about 50 per cent of static strength caused failure.

Single applications of loads 10 or 20 per cent above the repeated load appeared to extend the fatigue life of the small notched plate specimens.

THE EFFECTS of repeated high stress on severely notched members have received relatively little attention in the published literature. The purpose of this paper is to present data on several types of notched specimens which failed in less than 10,000 load cycles. Several types of specimens and tests were used, each of which had some engineering significance at the time, and some general principles seem to be applicable to all the results obtained.

Procedure

Material used was from a large forging with the following properties:

Physical Properties		Composition, per cent	
Tensile strength, psi	99000	Ni	2.92
Yield strength, 0.02 per cent, psi	75700	Mo	0.55
		V	0.07
Reduction of area, per cent	44	C	0.24
		P	0.026
Impact transition temperature, deg Fahr. (50 per cent ductile appearance)	200	S	0.023

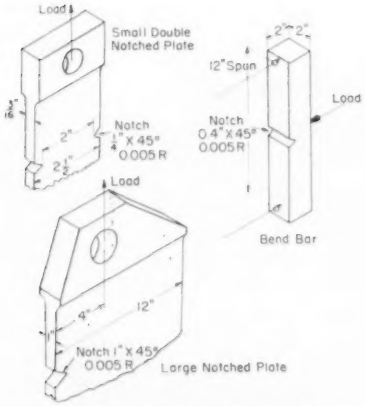

Fig. 1.—Three types of notched specimens.

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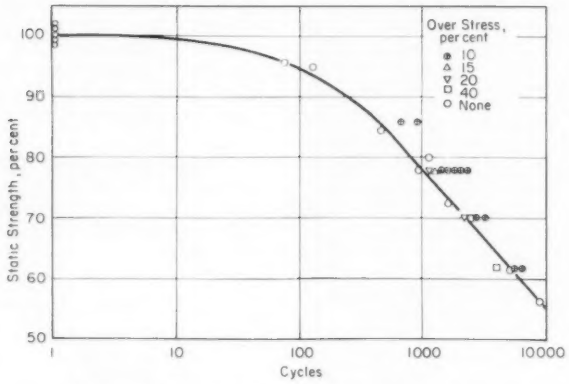

Fig. 2.—Test results for small double-notched plate.

The types of specimens used are sketched in Fig. 1. These will be referred to as the small double-notch plate specimen, the large notched plate specimen, and the notched bend bar. The *S-N* curve for the small double-notch plate specimen was first established with zero stress ratio out to 10,000 tension cycles. Identical specimens were then run at stress levels corresponding to fatigue lives between 500 and 5000 cycles. Single-cycle overloads of from 10 to 40 per cent above the cyclic stress were applied to these specimens at various stages of their fatigue life. The specimens were then continued to failure at the original stress level. Tests were made with large notched plate specimens

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JOHN McMULLIN received his Sc.D. in Metallurgy from M.I.T. in 1952, when he joined the staff of the General Electric Research Laboratory. In 1954 he became Supervisor of Metallurgy Applied Research in the Materials and Processes Laboratory of the Large Steam Turbine-Generator Department. In 1959, he joined the staff of the Central Research Laboratory of the Crucible Steel Co. as a research supervisor. Most of his research has been concerned with alloy steels and high temperature alloys.

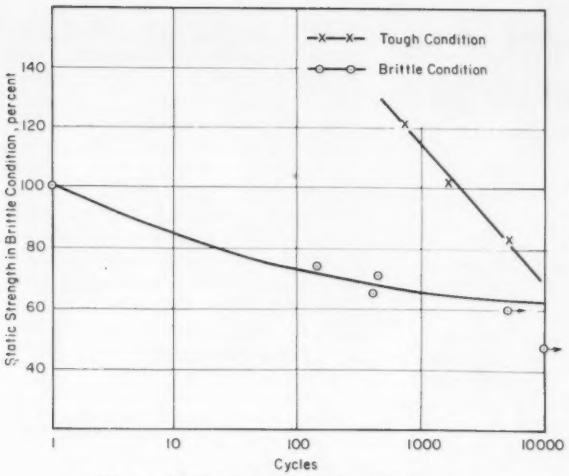

Fig. 3.—Test results for large notched plate.

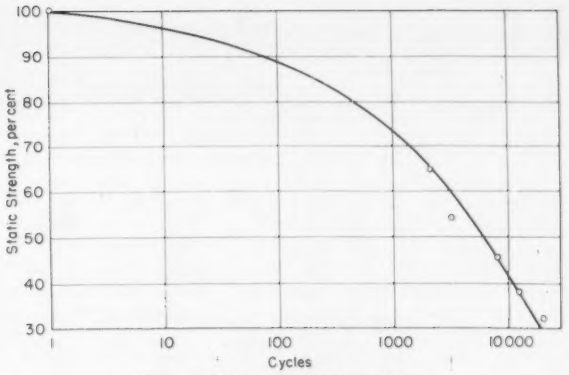

Fig. 4.—Test results for bend bar.

as received and as reheat-treated to a "notch-ductile" condition. The large plate specimens were also tested with zero stress ratio. These specimens were eccentrically loaded to simulate the stress distribution in a structural component pertinent to these tests. The bend test specimens were tested in three-point bending with the notched side in tension.

Results

The results are reported in Tables I and II. Figure 2 summarizes the results obtained on the small double-notch plate specimens. The 10,000-cycle strength of this specimen was about 50 per cent of its static strength. Specimens broken in a single load application exhibited an area of brittle fracture just under the notch, but the balance of the fracture was ductile. In specimens run at lower loads, a characteristic fatigue fracture extended in from both notches to a depth such that the stress on the remaining area approached the static strength at which the specimen failed in a predominantly ductile manner. In most specimens there was still a small area of sudden brittle fracture at the end of the fatigue crack. Data points for specimens subjected to single overstress cycles are also shown in Fig. 2. The 10 per cent and 15 per cent overloads appear to increase the fatigue life while 20 per cent and 40 per cent overloads seem to have little effect.

In Fig. 3 the results obtained on the large notched plate are shown. In the "notch-brittle" condition the fractures were all of the cleavage type except for a short length (approximately $\frac{1}{16}$ in.) of characteristic fatigue in those specimens which ran for several hundred cycles. In the "notch-ductile" specimens, the fatigue cracks progressed to a depth of over 1 in. and the specimens failed in a ductile manner. The nominal stress at fracture corrected for fatigue crack depth but not for stress concentration was essentially the same in all three ductile specimens. The single-cycle strength of the ductile specimens was beyond the 300,000-lb capacity of the testing machine.

The results of the tests on the 2-in.-square notched bend-test specimens are summarized in Fig. 4. In these specimens the fracture proceeded to a depth of 0.2 to 0.8 in. by fatigue and then changed to a typical cleavage-type fracture. The final nominal stress at the initiation of brittle fracture (corrected for crack depth but not for stress concentration) appeared to increase with the duration of the test.

Discussion

Analysis of the results disclose three rather important trends. First, it appears that 10^4 loading cycles can produce failure at a nominal stress level only 50 per cent as great as the static strength of a specimen. This relationship seems to apply to all three types of specimens investigated.

Second, the final brittle fracture may initiate suddenly after very little growth of a fatigue crack. The tests on the large notched plate demonstrate this effect very well. When the same type of specimen was heat treated to a tough condition (impact transition temperature of 80 F) the fatigue crack pro-

TABLE I.—SMALL DOUBLE-NOTCHED PLATES.

Applied Stress		Cycles to Failure	Total Depth of Fatigue Crack, in.	Corrected Stress at Failure, kpsi
kpsi	per cent of static strength			
97 (average of 5 specimens)	100	1	0	97
93	96	72	0.125	99.5
92	95	122	0.182	101.5
82	85	474	0.281	96.5
77.5	80	1053	0.375	95.5
75	77	971	0.375	92.5
75	77	1224	0.360	91.5
70	72	1589	0.485	92.5
67.5	70	2277	0.510	90.5
60	62	5312	0.672	90.5
55	57	9153	0.735	87.5

SINGLE CYCLE OVERLOAD ON SMALL NOTCHED PLATE

Applied Stress		Overload Stress, per cent	Cycles Prior to Overload	Cycles to Failure	Increase in Life, per cent
kpsi	per cent of static strength,				
82.5	85	10	65	668	49
82.5	85	10	260	914	103
75	77	10	50	1764	76
75	77	10	150	1416	42
75	77	10	300	1536	54
75	77	10	600	1723	72
75	77	10	800	1607	61
75	77	15	150	1347	35
75	77	20	150	1187	19
67.5	70	22	435	2128	−12
67.5	70	10	435	3212	33
67.5	70	10	1740	2636	10
60	62	38	840	4050	−10
60	62	10	840	6552	17
60	62	10	3360	5706	2

TABLE II.—LARGE NOTCHED PLATES.

Applied Stress		Cycles to Failure	Total Depth of Fatigue Crack, in.	Corrected Stress at Failure, kpsi
kpsi	per cent of static strength,			
As Received, Transition Temperature = 200 F				
84.3	100	1	0	84.3
62.4	74	122	0.07	62.4
60	71	458	0.13	60
55	65	411	0.13	55
51	60	5 000	0.4	Ran out
40	47	10 000	0.15	Ran out
Reheat-Treated, Transition Temperature = 80 F				
103	122[a]	733	1.78	167
85.7	102[a]	1 744	2.3	162
70	83[a]	5 224	3.25	177
2-in.-Square Notched Bend Bars				
140	100	1	0	140
92.0	66	2 066	0.32	143
76.8	55	3 362	0.52	168
65.2	47	8 286	0.55	151
53.6	38	13 246	0.70	169
46.0	33	20 877	0.79	180

[a] Based on static strength in "notch-brittle" condition.

gressed to a substantial depth until the stress on the remaining area was high enough to cause a ductile-type failure. The small double-notched plate specimen did not demonstrate this effect because it was too thin to fracture in a truly brittle manner in tests at room temperature. In the bend-test specimens, no tests were run at a high enough stress level to initiate brittle fracture in less than 2000 cycles, during which time a substantial fatigue crack grew. With very similar specimens of the same steel, fractures produced in a few hundred cycles showed little or no fatigue crack propagation.

Third, in the few samples tested, the 10 per cent and 20 per cent single overloads during the testing of the thin double-notched specimens tended to increase the fatigue life of these specimens.

Acknowledgment:

The tests on the small notched plate specimens were designed and carried out by J. W. Clark.

Discussion of Paper on a Modified Vicat Type Apparatus for Measuring the Softening Point of Thermosetting Plastics and Laminates[1]

Mr. N. R. Miller.[2]—Mr. Ehlers describes a modified Vicat test apparatus, and compares this apparatus with "commercially available Vicat sets." There are undoubtedly some applications where this modified apparatus would have certain advantages, but it is felt that some of the disadvantages attributed to the commercially available equipment are unjustified.

The commercially available unit used as a basis for comparison is described as an "electric air oven." ASTM Method D 1525[3] specifies that the heat-transfer material shall be a liquid; British Standard No. 2782: Part 1: 1956, Method 102 D, also specifies a liquid as the heat-transfer material. Consequently, the disadvantages cited as applicable to conventional Vicat sets are not justified, since commercial sets are, or should be, liquid baths. The following information and data have been collected from tests conducted on a commercially available liquid-bath apparatus.[4]

1. Instead of a "single heating element," the apparatus has three heating elements, automatically controlled to provide constant or cycling heat to achieve a uniform rate of temperature rise.

2. The temperatures at different positions in the apparatus do not vary considerably, and no correction tables are necessary for testing four specimens simultaneously.

3. The upper temperature limit of this apparatus is 260 C, which has been adequate for practically all requirements to date.

4. The apparatus is completely automatic in operation and requires no normal adjustment of a variable transformer as described for the modified apparatus.

5. A coil is provided in the apparatus to permit rapid cooling of the bath liquid after each test (by circulating water or other liquid, or gas).

6. No tests have been made to determine the differential expansion between the loading rod and the specimen support with the Vicat needle and the 1000-g load. However, using the loading rod specified in ASTM Method D 648,[5] a 2495-g weight, and a ½ by ½ by 5-in. pyrex specimen, the deflection at 150 C is approximately 0.02 mm.

The modified apparatus described in Mr. Ehler's paper would have advantages in certain applications such as very high temperatures and for materials that react with liquids. But for most conventional applications, the liquid-bath type has many advantages.

Mr. G. F. Ehlers (*author's closure*).—The description of the "commercially available Vicat set of the original type" given in my paper refers to the set as it was originally developed (and is still in use) in Germany. I was pleased to learn from Mr. Miller that units are available which meet the requirements of ASTM Method D 1525 and which provide a significant improvement over the original set. I agree with Mr. Miller that the unit he described will be useful for many applications.

It should be pointed out that the apparatus, as it is used in this laboratory for high temperature materials, is a prototype apparatus and can still be improved, as for example, by replacing the variable transformer by an automatic device.

[1] G. F. Ehlers, "A Modified Vicat Type Apparatus for Measuring the Softening Point of Thermosetting Plastics and Laminates," ASTM Bulletin No. 236, Feb., 1959, p. 54 (TP 64).

[2] Engineer, American Instrument Co., Silver Spring, Md.

[3] ASTM Tentative Method of Test for Vicat Softening Point of Plastics (D 1525), 1958 Book of ASTM Standards, Part 9, p. 406.

[4] American Instrument Co., Inc., Silver Spring, Md.

[5] ASTM Method of Test for Deflection Temperature of Plastics Under Load (D 648), 1958 Book of ASTM Standards, Part 9, p. 376.

Technical Note: The Use of Molded Activated Carbon Getters in Sealed Electrical Instruments*

FAILURE of contact points in sealed and hermetically sealed instruments has concerned engineers for a long time. National Carbon Co., a Division of Union Carbide Corp., became interested in this problem when the source of the trouble was traced to volatile organic matter, the thought being that activated carbon could be used to adsorb the volatiles and thus eliminate the problem. Activated carbon, one of the most effective adsorbents known, is used in recovering solvents, in gas purification, and in air conditioning.

Source of the Problem

It is fairly well established that outgassing or degassing of molded and laminated plastic materials within an instrument is the chief source of organic contamination. In addition, however, many other vapors are given off from adhesives, paper, cloth, wire, enamels, varnishes, oil, and other construction materials. Manufacturing contaminants such as volatile matter from resin-type solder fluxes and solvent vapors remaining from degreasing or cleaning operations may also be present.

As expected, the outgassing or volatilization of these materials is greater at elevated temperatures, but contact troubles have also developed even with an operating temperature in the range of 30 C. One explanation of what happens is that the vapors, once freed, are adsorbed on the fresh, noble metal surfaces of the contact points. In the heat of the arc, the deposited organic vapors are decomposed by the catalytic action of the contacts and produce free carbon and nonconductive carbonaceous com pounds.

Two Ways To Solve It

Since the problem is caused by organic vapors, there are two ways of attacking it. One, of course, is to eliminate all of the organic materials that could possibly volatilize. This means the substitution of relatively expensive metal and ceramics for molding resins. It means the use of nonvolatile plastics or materials with exceedingly low vapor pressures as insulation, and it means very careful cleaning of metal parts with residue-free solvents.

The other way to remove this contamination is to use whatever materials and manufacturing methods are convenient and then to remove the vapors which are generated with an adsorbent agent, or getter. The National Carbon Co. has recently developed such a getter, composed of a molded, resin-bonded, activated carbon which can be made into any shape or form, the only manufacturing limitation being a 3-mm minimum thickness. In a recent test, the contact resistances of new switches produced with normal contacts and those which had been stored over activated carbon getters prior to assembly were compared. The lower contact resistance found in the latter switches indicated the affinity that the getters have for organic contaminants. A useful test for evaluating activated carbon performance measures the amount of carbon tetrachloride that will be adsorbed under certain standard conditions. Using this test, we find that the getters will adsorb 50 per cent of their own weight, which places them in the same performance range with commercial granular activated carbons.

Strength of Molded Getters

Because many instruments are intended for use in aircraft and missiles, shock and vibration tests are of interest. One type of test was performed by fastening three carbon blocks to a square aluminum fixture with an epoxy adhesive. The test period was 1 hr with a vibration schedule of 15 to 75 cps at 0.036-in. double amplitude, and 75 to 2000 cps at ± 20 *g*. Fastened around the aluminum fixture was a white cup to catch any particles that might be shaken from the carbon getters. At the end of the test period, there was no carbon in the cup. The carbon getters were then mounted on an instrument case and the assembly subjected to a 30-min cycle. This vibration schedule ran from 50 to 400 cps at ± 3 *g*, and then from 400 to 2000 cps at ± 50 *g*. In this case also, no carbon particles were dislodged. It is interesting to note that at 1500 cps, resonance developed in the case on which the getter was mounted, resulting in a *g* amplification of 100. Even with this exposure, equivalent to 1500 *g* for 1 hr, no breakdown of the molded carbon block was evident.

A strength test of a cantilever-beam specimen was made on one of these blocks by fastening it to an aluminum fixture with epoxy resin and placing a yoke around the block loaded with a 25-lb weight. The carbon did not break or chip, even though the 25-lb pull was equivalent to a shock load of about 20,000 *g*. These results clearly show that the carbon getters are strong enough to be used in many applications.

Many manufacturers now bake their instruments before they are sealed; this process, in most cases, reduces the chance of contamination considerably. However, residual oily hydrocarbons held in lap joints, and even soldering flux over long periods of operation particularly at increased temperature, can cause additional vapors to be emitted within the sealed instrument, and the carbon getter will then be found useful in removing the new vapors as they are generated. In one case, the getter was found to be so effective that the baking process was eliminated altogether.

Many Possible Uses

Carbon getters have use in relays, converters or choppers, motor protectors, motors, switches, and for the storage of new contact points and semiconductor components. In the latter two applications, a carbon getter can easily be dropped into the container in which these materials are stored, thereby keeping them free from gaseous contamination.

It is felt that about 0.6 g of molded carbon should be used in 5 cu in. of total instrument space. This figure can vary over wide limits because of the many diverse types and sizes of units, and the best method of estimating is simply to apply a factor of safety to the above figure and use as much carbon as possible, consistent with the amount of free space. Various shapes can easily be formed. For instance, if there is only a small space in the corner of a case, a specially shaped getter could easily be produced to fit. We have found that one of the best ways to install a getter is to fasten it to the wall of the instrument with Armstrong epoxy adhesive type A-2, or some similar adhesive. The epoxy resins are particularly suitable since they have extremely low vapor pressures and do not affect the adsorptivity of the carbon to an appreciable extent. Another means of installation is a small metal clip brazed or soldered to the instrument.

J. R. LASKIE
National Carbon Co., Cleveland, Ohio

* Presented at a meeting of Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts, Boston, Mass., June 26, 1958.

New Concrete Joint Sealant Testing Machine

By R. J. SCHUTZ and A. VAN HAUTER

IN DEVELOPING new sealants for heavy and building construction, our research workers found that available testing machines did not provide the needed information on all the qualities of joint sealant materials.

One machine, described in Federal Specification SSR-406-C, is capable of extending three joints at a fixed rate and does an excellent job of testing for compliance to the given specification. However, it does not have the necessary versatility for use as a research tool.

The Portland Cement Assn. has also designed and built a very fine testing machine. But it, too, is limited as a tool of research.

As new materials, particularly the new elastomeric sealants were developed, with their increased capabilities for sealing joints in concrete and other materials, it became desirable to develop a machine that could perform the following functions:

1. *Extension test:* The standard compliance test (extend a 1-in. joint at the rate of ½ in. in 4 hr), Federal Specification SSR-406-C.

2. *Compression test:* As concrete expands, joint sealants are compressed. A test cycle involving measured compression is highly desirable since the reaction of the material to compressive loads may conceivably affect the integrity of the joint.

3. *Variable rates of load application:* Certain joints similar to those in bridge decks are subject to more rapid movement than those prescribed by Federal specifications. Therefore, a machine used as a research tool should be able to apply loads at a variety of rates if actual field conditions are to be simulated.

4. *Force necessary for extension and compression:* Since adhesive and cohesive characteristics of sealants may vary independently with temperature changes, it is necessary to measure forces under varying conditions if success of sealant in the field is to be adequately predicted.

5. *Test for maximum extension:* These data are necessary to design joints using the method described by Egon Tons in his paper presented at the Highway Research Board meeting in January, 1959.

6. *Fatigue failure:* How long a joint sealant will continue to serve its purpose is a significant factor in determining its economy. By repeated cycles of compression and tension under controlled conditions the life of a sealant can be predicted.

7. *Environmental testing:* Since joints will be subject to a wide range of climatic conditions, a testing machine should be capable of performing the above tests under a wide range of temperature and humidity conditions.

Components

The machine consists of the following elements: power source, chain drive, gear-reducing system, driving screws and loading heads, recording devices, and carrying frame. The machine weighs about 600 lb, is 24 in. wide, 38 in. long, and 32 in. high. It is mounted on wheels for mobility. See Fig. 1.

Loading

The load is applied through six moving heads arranged in two rows of three each. The specimens are prepared as prescribed by ASSHO specifications and are clamped between the fixed head and the moving head. When the motor is turned on, the head fixed to the driving screw moves in one direction or the other, as required, thereby applying either a compressive or tensile load. See Fig. 2.

As the test proceeds, an actuating arm moves in the same direction as the driving screw. This arm, after a preset distance of travel, trips a reversing

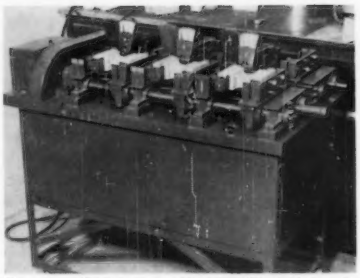

Fig. 1.—Testing machine will test up to six specimens at once (three shown under test above). Note that failure of one specimen will not affect testing of other two specimens in machine.

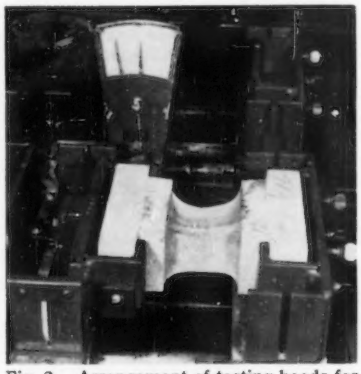

Fig. 2.—Arrangement of testing heads for single specimen is shown above. Note deflection plate and lever arm in left head which activates load gage directly to the rear. Moving head, right, travels along drive screw at prescribed rate. Direction of travel may be reversed instantly.

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ALBERT G. VAN HAUTER has been chief of the Mechanical Department, Engineering Laboratories, of Sika Chemical Corp. for the past two years. An associate member of the Society of Professional Engineers, he has been engaged in research and development of specialized test and production equipment for Sika Chemical Corp., Eleckraft Corp., and Wright Aeronautical Division of the Curtiss-Wright Corp.

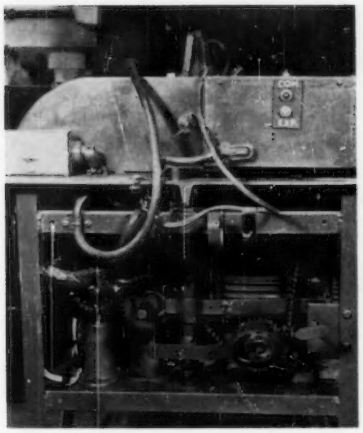

Fig. 3.—Electric motor is mounted directly beneath testing table. Note compression-expansion switch, upper right. Direction of travel may also be reversed by actuating arm which trips reversing switch on testing table.

switch, which changes the direction of rotation of the motor and thereby the direction of the loading. Although present models of the machine are not so equipped, a counting device could be attached to the testing table to record the number of load cycles.

Load Indicator

Each of the moving heads is equipped with a deflection plate attached to a lever arm which in turn moves a load indicator, calibrated in pounds. Scales on the indicators are calibrated for the three ranges of deflection plates used and are read directly. Each one of the indicators is equipped with a recording needle which automatically indicates the maximum load at failure. Each of the moving heads is equipped with a separate load indicator.

Power Source

The power source is a 1750-rpm, $\frac{1}{4}$-hp, electric motor (Fig. 3). Direct gearing reduces the speed to 1 rpm. The chain drive to the specimen-head driving screw reduces the ratio further

Fig. 6.—Test to failure of mastic joint sealer indicates that tensile strength of material exceeds its bond to concrete. Testing machine will indicate at what stress bond will fail so that joint may be designed to preclude overstressing.

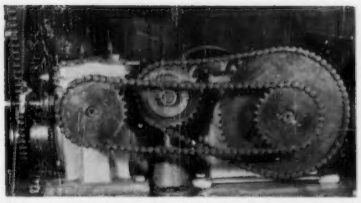

Fig. 4.—Entire power takeoff is reduced through chain and gear linkage so that there is no slippage or variation in speed when reversing cycle. First and second gear reduction units are enclosed and run in oil cases.

to 2 revolutions per hr; the screw, having a pitch of 16 turns per in., gives the required $\frac{1}{8}$ in. travel per hr. The entire unit is a chain and gear linkage, (Fig. 4), so that there is no slippage or variation in speed with direct or reverse cycling. The speed reduction virtually precludes overloading of the driving motor by any sealant now envisioned. The first and second gear reduction units are enclosed and run encased in oil, thus ensuring long and trouble-free service.

Research Applications

Some of the tests already carried out on this machine are shown in the following illustrations:

In Fig. 5 a mastic-type sealant has been extended to failure. As can be seen, the material failed in cohesion. The testing machine recorded the load at which this failure occurred. With this information it is possible to specify the maximum per cent extension permissible in a joint sealed with this type of material.

A typical adhesive failure of a mastic-type sealant is shown in Fig. 6. Such

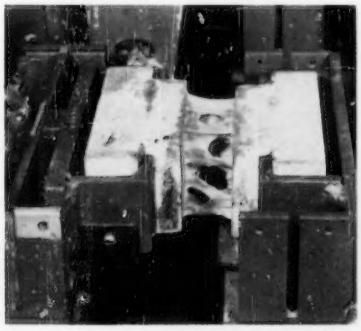

Fig. 7.—Epoxy sealants exhibit different qualities requiring more complete testing data. Note material above still joins concrete surfaces, bond is unbroken, and part of the material still takes tension. However, internal stress failure has progressed to the point where material would no longer serve as a sealant. Joint shown was originally $\frac{1}{8}$ in. wide, and was extended 650 per cent to failure. Extent of movement material is capable of before failing in this manner is significant to the proper design of joints.

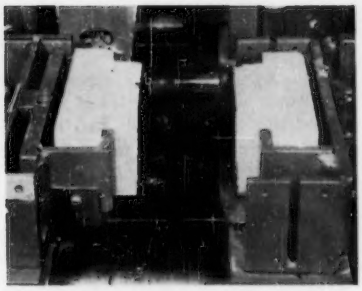

Fig. 5.—Full extension of head shows cohesive failure of mastic sealant. Machine will record load at which this failure occurred.

failures usually occur as temperature is decreased. Since mastic-type sealants increase in hardness and cohesive strength at lower temperatures, the sealant will fail in bond at the point where cohesive strength exceeds adhesive strength. Knowing at what temperature this occurs, the designer can apply both adhesive and cohesive criteria in his design for the anticipated range of temperatures.

So far, mastic-type sealants have been discussed. Elastomeric-type sealants exhibit characteristics which are quite different. Particularly striking are the higher adhesive and cohesive strengths. Illustrated in Fig. 7 is a concrete-to-concrete joint which has been extended 650 per cent from its original $\frac{1}{8}$ in. width. While the material is still bonded to the concrete surfaces and some of the material is still taking tension, internal failure has progressed to the point where the material would no longer serve as a sealant. Such internal failure is usually considered to result from air bubbles trapped in the sealant. These air bubbles are points of weakness from which internal failure develops. When such failure occurs, the surfaces of the sealant lose their characteristic parabolic shape.

Figure 8 illustrates an elastomeric-

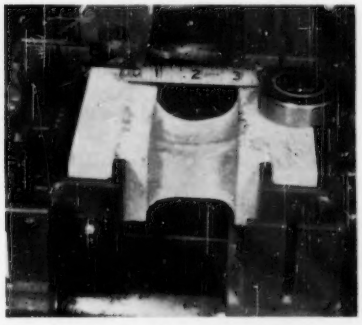

Fig. 8.—Scucessful joint sealant test shows material to have taken 100 per cent extension of joint width and the bond is still intact. Note characteristic parabolic curve of faces of extended joint material.

type sealant which has been extended 100 per cent and is still intact. Note the characteristic parabolic curve conforming to the theoretical equation developed by Egon Tons. If any internal failure had taken place during this test the shape of the sealant would not conform to this curve.

Plotting Sealant Characteristics

Among the data needed on sealants are temperature *versus* tension. The lowest temperature at which a sealant can successfully perform is determined by the relation of its adhesive to its cohesive strength at that temperature. Further, if the sealant is bonded to concrete or mortar, the performance of the joint itself may be determined by the tensile strength of the mortar at the sides of the joint. This mortar may have a tensile strength of 80 to 100 psi. If the force necessary to stretch the sealant exceeds this, the joint will fail in the concrete.

Figure 9 illustrates the results of tests showing strength *versus* temperature. Tests of this kind indicate climatic conditions under which a sealant may be most effective. Notice that in the case of sealant A, with a small drop in temperature below 30 F, a much larger tensile force is required to stretch it. This particular sealant would not be suitable for low-temperature service since a small movement at low temperatures would impose a high adhesive stress. Sealant B, on the other hand, shows a relatively small change in tensile force with changes in temperature; consequently, it would be much more suitable for use in extremely low temperatures.

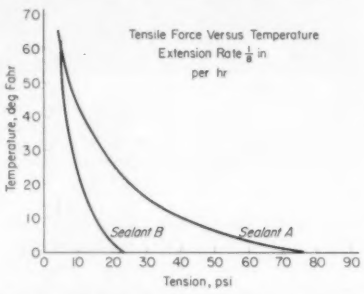

Fig. 9.—Tension *versus* temperature curve of two sealants clearly indicates sealant A is unsuited to cold-weather construction since at low temperature tensile force required climbs sharply. Sealant B, on the other hand, would work well since there is a relatively small change in tensile stress with change in temperature.

Conclusion

When investigating sealants it is highly desirable to have quantitative information with respect to load conditions rather than a mere knowledge of the ability of the material to extend at a given temperature. The information thus gained will enable the designer to predict the performance of a joint system under actual field conditions.

The tests described herein are only illustrative of many uses to which the machine may be put. As we delve deeper into the mechanics of sealant materials, we are certain that more test programs will be devised. With the advent of new and refined joint sealing materials, particularly the epoxy resins, the horizons of joint design have been greatly enlarged. To avail ourselves of the better designed structures now possible, it is necessary to learn more about the physical properties of sealants. The new joint sealant testing machine described above will provide many of the answers to the mechanics of joint design and the properties of joint sealing materials.

Specimen Deflection Determination from Crosshead Travel in Three-Point Flexure Tests

By C. D. DOYLE and W. V. OLSZEWSKI

This paper presents a procedure for determining specimen deflection from crosshead travel in flexure tests in a lightweight test fixture for use at subnormal and supernormal temperatures. The correction procedure is applied to data for 52S aluminum, general-purpose polystyrene, and polyester- and epoxy-glass laminates.

WHEN large numbers of specimens must be tested at temperatures above or below room temperature, flexure tests are less difficult to run than tension tests because it is comparatively easy to mount and align a flexure specimen in the test fixture. If an extensometer must also be mounted and aligned, however, much of the advantage of flexure testing is lost. For this reason, it is desirable to (1) determine flexural deflection from crosshead travel when the tests are conducted in an oven and (2) to use a lightweight flexure fixture which can quickly be heated or cooled to the test temperature.

Experimental Procedure

The three-point flexure tests described in this paper were conducted according to the provisions of ASTM Method of Test for Flexural Properties of Plastics (D 790)[1] except that the flexure test fixture was designed for operation within an oven. Figure 1 shows the fixture with the oven removed. The specimen is balanced on the loading nose, which is suspended from the load-sensing cell of an Instron ma-

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WILLIAM V. OLSZEWSKI, mechanical technician in the General Engineering Laboratory, General Electric Company, Schenectady, N. Y., has been engaged in the physical testing of plastics since 1952.

[1] 1958 Book of ASTM Standards, Part 9.

TABLE I.—DIMENSIONS OF COMPARATIVE TEST SPECIMENS AND APPLICATION OF MACHINE CONSTANT K TO DATA OF THESE MATERIALS.

Material	L, in.	b, in.	d, in.	Stress Range, psi	L/d	Strain Rate, in. per in. per min	Ea, psi	E, psi
52S aluminum	3.0	0.500	0.188	6 400	16.0	0.006	6.460×10^6	$10.800 \times 10^6 \pm 4.0$ per cent
General-purpose polystyrene	2.0	0.927	0.122	3 300	16.4	0.009	0.485×10^6	$0.511 \times 10^6 \pm 2.1$ per cent
Crossplied polyester-glass laminate[a]	2.0	0.970	0.125	10 000	16.0	0.009	2.390×10^6	$3.370 \times 10^6 \pm 3.5$ per cent
Crossplied epoxy-glass laminate[b]	2.0	1.009	0.124	10 000	16.1	0.009	2.430×10^6	$3.460 \times 10^6 \pm 3.0$ per cent

[a] Laminac 4119, 181 glass, and Volan A finish.
[b] Bakelite ERL 2774, methylene dianiline hardener, 181 glass, and Volan A finish.

chine through a universal joint. During the test, the ends of the specimen beam are pulled down by the supports, which are firmly fixed to the crosshead of the machine. The span between the supports is continuously adjustable from 6 down to 2 in.

Designed to be light in weight, the fixture shown in Fig. 1 does not satisfy the testing machine stiffness requirement of Method D 790 that the total elastic deformation of the testing system must not exceed 1 per cent of the test specimen deflection. In the present case, this requirement has been waived in favor of the provision that the deformation of the testing assembly must be completely elastic for all practical purposes.

The tests described in this paper were conducted at 24 C, 50 per cent RH, and at a crosshead speed of 0.05 in. per min. Although the Instron D cell would normally be used in the load ranges employed, the C cell was used as the load sensing device to magnify the machine deformation error for demonstrative purposes.

Specimen Deflection and Crosshead Travel

The amount of crosshead travel for a given load on a given specimen beam is always greater than the actual deflection at the beam center unless the specimen bends to a radius smaller than that of the loading nose.[2,3] This is because part of the crosshead travel is taken up in tightening the hold of the gripping fixture on the specimen and elastically stretching or bending the components of the testing assembly that are under load.

Most of the gripping error varies nonlinearly with the load and is easily corrected. In some cases, however, there is a small, but significant, fraction of the gripping error which varies almost linearly with the load. Correction of this part of the gripping error is more difficult. The machine

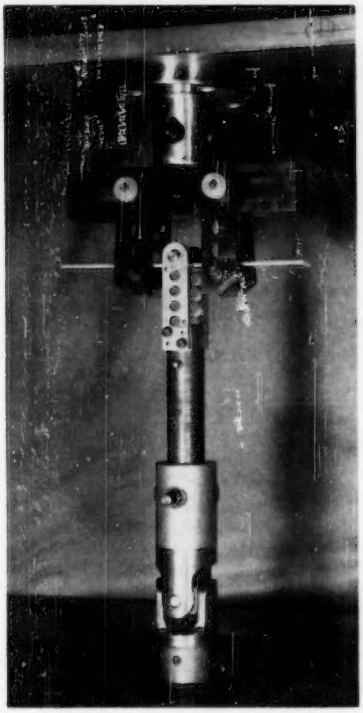

Fig. 1.—Flexural test fixture for operation within oven.

deformation error in a properly designed testing assembly is fully linear and is easily corrected by straightforward calibration techniques.

The nearly linear part of the gripping error is believed to be due to the flattening of small, isolated high spots in the surface of the specimen. It can be detected by subjecting a specimen to three consecutive load-unload tests in which the maximum applied load represents approximately two thirds of the proportional limit stress (the stress at which the load-deflection curve becomes nonlinear). In tests on some materials, the crosshead will travel appreciably further in applying a given load in the first run than in the second and third.

Thus, to correct the nearly linear part of the gripping error, it is necessary to preload each specimen to approximately two thirds of the proportional limit, then unload just to zero before starting the actual test. If the proportional limit is not known in advance, it can be determined with sufficient accuracy for preloading purposes by sacrificing the first specimen in a group. In some cases, it is possible to estimate the elastic limit on the basis of previous experience with similar materials. In other cases, previous experience will suggest that the linear error is negligible.

The nonlinear part of the gripping error can be corrected directly on the load-crosshead-travel chart. As shown in Fig. 2, the Instron machine plots a multiple of the load on the ordinate of the recorder chart and a multiple of the corresponding crosshead travel on the abscissa. The nonlinear gripping error is eliminated by extending the linear part of the load-travel curve down to the base line of the chart. The chart distance, D_a, measured from the beginning of the corrected load-travel curve, is taken as the basis for computing the corrected crosshead travel, y_a.

For any specimen bent to a radius greater than that of the loading nose and showing no sign of indentation by the supports and loading nose, the cor-

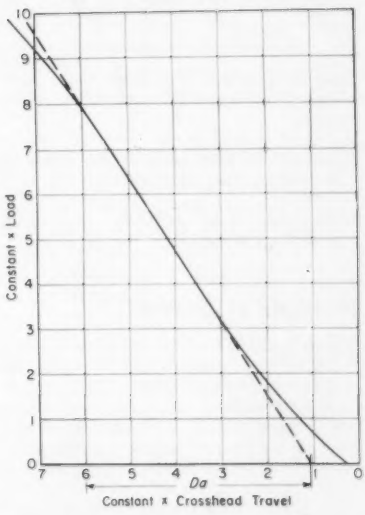

Fig. 2—Typical Instron machine plot of load *versus* crosshead travel.

[2] E. M. Schoenborn, G. R. Proctor, and J. Carvajal, "The Effect of Width and Span-Depth Ratio on the Flexural Strength of Laminated Plastics," ASTM BULLETIN, No. 134, p. 42 (May 1945).
[3] J. W. Westwater, "Flexure Testing of Plastic Materials," *Proceedings*, Am. Soc. Testing Mats., Vol. 49, p. 192 (1949).

rected crosshead travel is related to the actual specimen deflection, y, by the equation:

$$y = y_a - y_e \quad \ldots\ldots\ldots (1)$$

where y_e is the machine deformation error. In a properly designed testing assembly, the machine deformation error is linear with the load, P:

$$y_e = KP \quad \ldots\ldots\ldots (2)$$

The value of the constant, K, applies only to a particular combination of testing machine, load-sensing cell, gripping fixture, and associated pull rods and connecting pins.

The machine deformation constant can be evaluated by conducting flexure tests on a bar of material of known Young's modulus at loads below the material's proportional limit. In conducting the calibration test, it is extremely important that the span-to-depth ratio of the test specimen be held at 16 ± 2. Both the accuracy and the precision of the determination of K depend strongly on the span-to-depth ratio. If the specimen is too stiff, errors due to indentation of its surface may become apparent. A specimen which is too pliant may bend in irreproducible fashion or may assume bent shapes which differ appreciably from the circular arc of simple beam theory.

The value of K is computed on the basis of the equation for Young's modulus, E, in flexure:

$$E = \frac{L^3P}{4bd^3y} \quad \ldots\ldots\ldots (3)$$

where L, b, and d are the span, width, and depth of the specimen, in inches, and where E is expressed in pounds per square inch, the load, P, in pounds, and the deflection, y, in inches. The corresponding equation for the apparent Young's modulus, E_a, in terms of corrected crosshead travel, y_a, is:

$$E_a = \frac{L^3P}{4bd^3y_a} \quad \ldots\ldots\ldots (4)$$

From Eqs 1, 2, 3, and 4, the ratio of E_a to E is:

$$\frac{E_a}{E} = \frac{y_a - KP}{y_a} \quad \ldots\ldots\ldots (5)$$

which, solved for K becomes:

$$K = \left(1 - \frac{E_a}{E}\right)\frac{y_a}{P} \quad \ldots\ldots\ldots (6)$$

and, solved for E, becomes:

$$E = \frac{E_a}{1 - \frac{KP}{y_a}} \quad \ldots\ldots\ldots (7)$$

The value of K is determined by testing a material of known Young's modulus, as will be shown next.

Illustrative Examples

The test specimen used in calibrating the assembly shown in Fig. 1 was a piece of cold-rolled steel having a Young's modulus of 29.3×10^6 psi and the dimensions: $L = 3$ in., $b = 0.497$ in., and $d = 0.185$ in. The bar was tested ten times to loads ranging from 8000 to 13,000 psi at a crosshead rate of 0.05 in. per min which corresponds to a strain rate of 0.006 in. per in. per min. Prior to each of the ten tests, the specimen was positioned in the test assembly and preloaded to 8000 psi, then unloaded just to zero. The value of K was calculated from Eq 6. Its average was found to be 0.127 mil per lb.

The standard deviation was estimated according to the following relationship:

$$S = \sqrt{\frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}} \quad \ldots\ldots\ldots (8)$$

where S represents the estimated standard deviation, n the number of tests, and x the data for any particular test.

In the case under consideration, the standard deviation was estimated to be 0.003 mil per lb. The value of K was then applied to the data from similar flexure tests on the materials listed in Table I.

The findings are also listed in Table I together with the test loading stress range, specimen span-to-depth ratio, and the rate of strain corresponding to a crosshead rate of 0.05 in. per min. Corrected and uncorrected specimen deflections are compared in terms of the average apparent modulus, E_a, and the modulus, E, calculated from Eq 7. The coefficients of variation of E correspond to two standard deviations from the estimated mean.

The calculated values of Young's modulus in Table I are in good agreement with moduli determined from dynamic tests at low frequencies and with moduli for similar materials as cited in the handbooks. It should be noted, however, that this procedure is not recommended for the definitive determination of flexural Young's moduli and flexural strains. It is offered, rather, as a means of measuring specimen deflection with increased accuracy in case it is inconvenient or impossible to use stiff test fixtures or extensometers.

(*Continued from page 22*)

have been used in transformers and other electrical apparatus as insulating or cooling media.

Tentative Method of Test for Water in Insulating Oils by Extraction (D 1315 – 54 T)

Revision.—This method has been brought up-to-date.

Methods of Testing

Tentative Specifications for Apparatus for Microdetermination of Nitrogen by Kjeldahl Method (E 147 – 59 T)

New Tentative.—These specifications cover digestion and distillation apparatus used for the determination of nitrogen by the micro-Kjeldahl method and modifications thereof at atmospheric pressure. The specifications are based on specifications originally developed by the Committee on Microchemical Apparatus of the American Chemical Society. This is the second in a series of detailed specifications for microchemical apparatus being prepared by Committee E-1.

Methods of Testing Building Constructions

Tentative Method of Test for Bond Strength of Mortar to Masonry Units (E 149 – 59 T)

New Tentative.—This method covers a procedure for determining the bond strength between mortars containing hydraulic cements and the units used in masonry structures. The method was prepared at the request of the Structural Clay Products Inst.

Effect of Temperature on the Properties of Metals

Tentative Recommended Practice for Conducting Creep and Creep-Rupture Tension Tests of Metallic Materials Under Conditions of Rapid Heating and Short Times (E 150 – 59 T)

Tentative Recommended Practice for Tension Tests of Metallic Materials at Elevated Temperatures with Rapid Heating and Conventional or Rapid Strain Rates (E 151 – 59 T)

New Tentatives.—These recommended practices were prepared at the request of the Materials Advisory Board of the National Research Council in view of the critical need for this standardization in evaluating structural materials for aircraft and missiles.

Recommended Practice E 150 covers those tests involving faster heating rates and shorter times of testing than those covered by the Recommended Practice for Conducting Creep and Time-for-Rupture Tension Tests of Materials (E 139 – 58 T). Similarly, Recommended Practice E 151 covers tension tests using faster heating rates or faster heating rates in combination with faster straining rates than those covered by the Recommended Practice for Short-Time Elevated Temperature Tension Tests of Materials (E 21 – 58 T).

Random Samples. . .

FROM THE CURRENT MATERIALS NEWS

High-Pressure Effects on Solids

AT THE NATIONAL Bureau of Standards, spectroscopic studies of solids under pressure indicate that changes in molecular structures occur under pressures of 30,000 atmos.

The basic characteristics of matter are determined by interactions between atoms and molecules. Although the interactions between adjacent molecules are generally understood, the disturbances produced by interactions between more widely separated molecules are not. The Bureau is studying these interactions as part of its program of basic research on the physical constants and properties of materials.

Infrared spectroscopy is used in this work because the frequencies of absorption bands are determined by the characteristics of the molecular units present, such as the masses of the oscillating units, the forces between them, and the force fields of adjacent molecules. Intensities of these bands are functions of the electrical properties (dipole moments) and the number of the individual oscillators, as well as their distance from one another. When a specimen is compressed, these properties are modified by the reduced interatomic distances.

Determining changes in molecules under extreme pressure has been made possible by an apparatus containing two carefully ground diamonds with their flat surfaces perpendicular to a beam of light. Between these surfaces is placed a specimen to be studied. Because diamonds are hard and strong, high pressure can then be applied to the material between them, and the light passing through the diamonds and the specimen can be analyzed with a spectrometer. The specimen compressed between the diamond surfaces produces a very thin film suitable for infrared study.

Although diamonds are used because of their strength, not all diamonds are transparent in the infrared range. About 99 per cent of all diamonds, known as type I, show numerous absorption bands and are therefore unsuitable for pressure-cell windows. The remaining 1 per cent, known as type II, appear transparent between 0 and 35 μ, with the exception of one absorption band near 5 μ.

Pressure was found to weaken most of the absorption bands of calcite. The decrease of intensity was greater than one might expect to result simply from the restricted amplitude of oscillations. This greater decrease has not yet been explained.

For some materials, the spectrum showed new absorption bands, disappearance of normal bands, splitting of single bands, or combining of double bands.

These changes in spectroscopic absorption indicate distinct structural changes, but little correlation has been made between changes in pressure and the observed infrared patterns. It appears that use of diamonds in this way opens a new and promising field of study, but further research will be needed before adequate explanations can be made for the observed changes in the infrared spectra.

India to Sponsor Symposium On Metallurgical Pilot Plants

TO DESCRIBE the place of the pilot plant in the field of metallurgy, and to provide metallurgists from all over the world with a forum for exchange of know-how, the National Metallurgical Laboratory at Jamshedpur, India, will sponsor a Symposium on Pilot Plants in Metallurgical Research and Development, in February, 1960.

For technological innovations aspiring to cross the uncharted land between basic research and production, the pilot plant is often a useful testing ground—it weeds out the incompetent, who fall by the wayside; it tries the competent, who are strengthened by success. The pilot plant offers the sponsor of the innovation a chance to make his mistakes on a small scale, to find and eliminate bugs while the process is relatively inexpensive.

The gulf between metallurgical research on the one hand and industrial use of research results on the other is wide everywhere, and especially so in India. Thus, the role of the pilot plant assumes particular importance in that nation, only recently embarked on heavy industrialization through successive Five-Year Plans.

Topics to be discussed at the February meeting include: The relation between the pilot plant, the laboratory, and the industrial plant; present-day pilot plants in India and abroad; use of the pilot plant for studying such processes as mineral dressing, smelting, ore reduction, hot and cold working, and finishing; equipment for metallurgical pilot plants; the economics of applied processes; and the statistical analysis of pilot plant test data.

Additional information can be obtained from Mr. T. Banerjee or R. M. Krishnan, National Metallurgical Laboratory, Jamshedpur-7, India.

ISO Plastics Meets in Munich

Forms New Group on Specifications

INTERNATIONAL STANDARDS work in the field of plastics will include specifications for the first time, when the International Organization for Standardization (ISO) technical committee 61 on plastics holds its ninth annual meeting in **Munich, October 26–31.** Up to now, all the international standards under consideration in the plastics field have been test methods and terminology.

The secretariat of the ISO committee is held by the United States through the American Standards Assn. The USA National Committee, which is a special subcommittee of ASTM Committee D-20 on Plastics, serves in an advisory capacity to ASA for the ISO plastics project.

Since ISO 61 was organized in 1950, five test methods for plastics have been accepted as international standards, known as ISO Recommendations. Four more are in the final stage of approval by the ISO Council, and 25 others are being prepared for balloting by the standards organizations of the 41 member-nations of ISO. In addition, some 40 to 50 test methods are under active development in the committee's working groups. There are 21 nations actively working on the plastics standards project.

The new working group on specifications will hold its organization meeting at the Munich conference. The USA will be represented on this new group by E. Y. Wolford, Koppers Co., Inc., Pittsburgh, Pa.

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Photoelasticity by the slice

Westinghouse, long known as a hotbed of photoelastic activity, has been nice enough to cast upon the waters of industrial co-prosperity a piece of technique that could help sell more *Kodak Contour Projectors*. No time must be lost in spreading the word.

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Don't bother Westinghouse for a description of the optical, mechanical, and electrical additions they've made to the projector. It's enough that they are publishing a full description of the analytical method (Proceedings of the Society for Experimental Stress Analysis, *17*, No. 1). *They're not interested in selling projectors. Eastman Kodak Company, Special Products Division, Rochester 4, N. Y., is.*

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Bookshelf

Handbook for Brinell, Rockwell, and Vickers Hardness Testing

Georg Reicherter, Manufacturer of Measuring Instruments and Testing Machines, Esslingen a. N., Germany, 216 pp., illus., approximately $3.

Books reviewed here are furnished by publishers knowing of the broad interests of ASTM. Occasionally reviews are prepared by ASTM Staff members, but in most cases, the books are reviewed by Society members or other individuals who are well informed on the subject at hand. Members who wish to be considered for reviewing books are invited to send in their names and the subjects in which they are interested. Due to customs and mailing considerations, requests from the United States only can be considered.

Copies of these books are not available through ASTM; all inquiries concerning them should be addressed to the publisher.

THIS GERMAN-LANGUAGE handbook for the production man covers a very wide range of application of the three most common methods of hardness testing. The publication is not intended to be a textbook but is intended primarily for test and inspection personnel already familiar with the principles of hardness testing. The book explains test performance under various conditions and evaluation of the results. A great variety of practical test problems has been introduced to suggest expansion or simplification of control operations in the reader's own field of production. This book can help the reader to: (1) select the most appropriate of the three test methods, (2) avoid sources of error in the use of these methods, and (3) achieve reliable and truly representative test results.

The use of Rockwell and Vickers hardness tests with exceedingly small loads and the automation of hardness test operations in large-scale production are fully discussed. The author recommends the Rockwell test exclusively for automation because he regards it as the only standardized method for which one can design equipment capable of fully automatic classification and selection of a large and steady flow of production pieces.

Touching the always controversial subject of the extent to which hardness values are representative of tensile strength, the book gives for carbon steel (with tensile strength between 30 and 100 kg per sq mm) a strength value of approximately 0.36 times Brinell hardness (3000 kg, 10 mm, 10 sec), and for alloyed chromium-nickel steel (with tensile strength between 65 and 100 kg per sq mm) a strength value of approximately 0.34 times Brinell hardness. However, the author hastens to add that this relationship is empirical and that the Brinell hardness test should never replace a specified tension test. Conversions of this type are, of course, impossible for all types of castings and for non-ferrous metals, with the probable exception of aluminum alloys. The author is also skeptical of conversions of Rockwell to Brinell hardness and to tensile strength because of the absence of generally acceptable conversion methods, and considers it possible only in special cases after a reliable conversion basis has been established through comparison tests.

Being a long-established manufacturer of hardness test equipment, the author presents in connection with every test problem the applicable testing device from his production line. The prospective reader who might reject this procedure as unsolicited advertisement overlooks the most important point in favor of this book: few are in a better position to explain the use of a machine than the one who designed and built it.

G. G. DOCHNAHL

(*Continued on page 55*)

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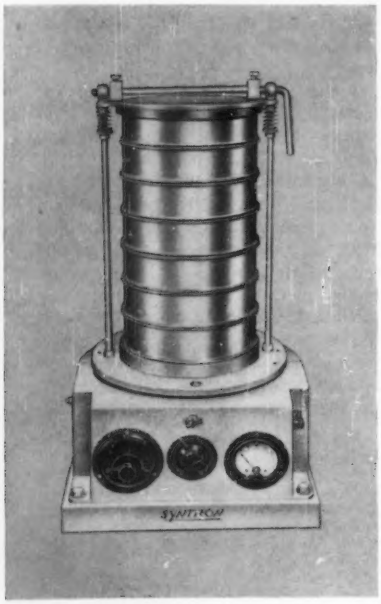

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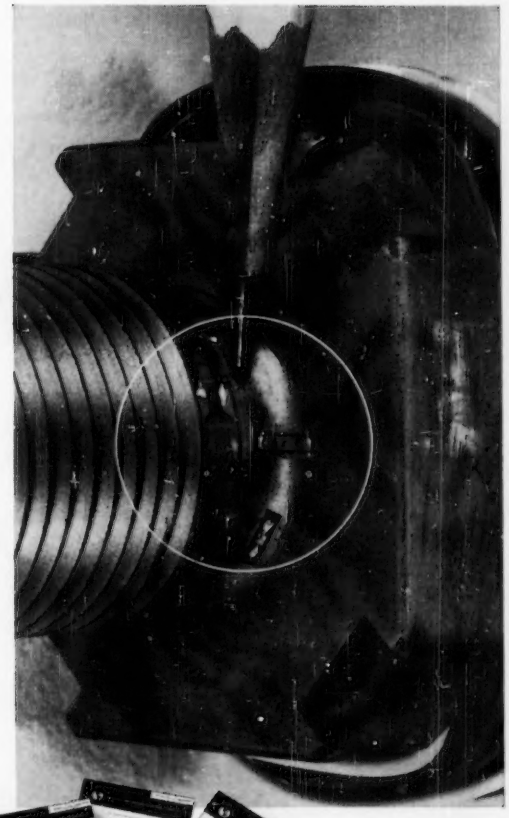

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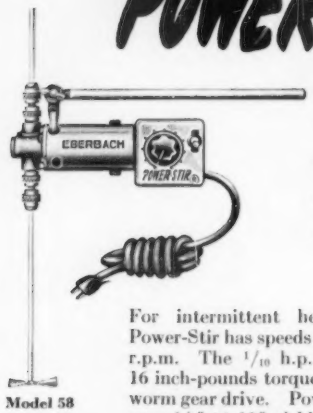

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Bookshelf

(*Continued from page 52*)

Building with Plastic Structural Sandwich Panels

Monsanto Chemical Co., Plastics Div.; Springfield, Mass.; 1958; 116 pp.; $3.00.

USE OF THE structural sandwich panel is a relatively new idea in building construction. Architects and builders visualize many new and exciting uses for plastics in sandwich panels for buildings in the future.

A comprehensive study to explore the architectural potentialities of sandwich construction was made at the Massachusetts Institute of Technology under a grant-in-aid from Monsanto Chemical Co. The report of this study, in very attractive format, is now available. Among the numerous illustrations are many sketches depicting the types of panel structures and the methods used for transferring loads. Chapter titles are: History, Design, Structural Analysis, Materials Technology, Fabrication Process, Handling, Operation, Erection Process, and Environmental Controls. The chapter on Materials Technology should be of particular interest to ASTM members.

Boron, Calcium, Columbium, and Zirconium in Iron and Steel

R. A. Grange, F. J. Shortsleeve, D. C. Hilty, W. O. Binder, G. T. Motock, and C. M. Offenhauer; John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., (1957); 556 pp.; $14.00.

THIS PUBLICATION is one of the monograph series, *Alloys of Iron Research*. Although none of the elements reviewed can be classified as major alloying elements, their importance came to be recognized during World War II, and since that time numerous publications have reported their effect on the constitution, heat-treatment, mechanical, and other properties of iron and steel. The authors themselves are well-known authorities in this field, with the resulting advantage that the review is truly critical. Many references are included in every chapter so that the value of this publication lies principally in its potential use as a reference book to available data in the field. For those research workers and others who are interested in the effects of alloying elements in steel, the valuable saving of time made possible by the availability of comprehensive summaries of the pertinent publications is obvious.

A few relatively minor inconsistencies of fact could be remedied in a subsequent edition. For example, on p. 450 two separate values for the free energy of formation of zirconium dioxide are reported, and the graphical thermodynamic data of Richardson and Jeffes on p. 69 is wrongly attributed to Chipman. However, this does not detract from the usefulness of the book.

The authors are to be congratulated

(*Continued on page 56*)

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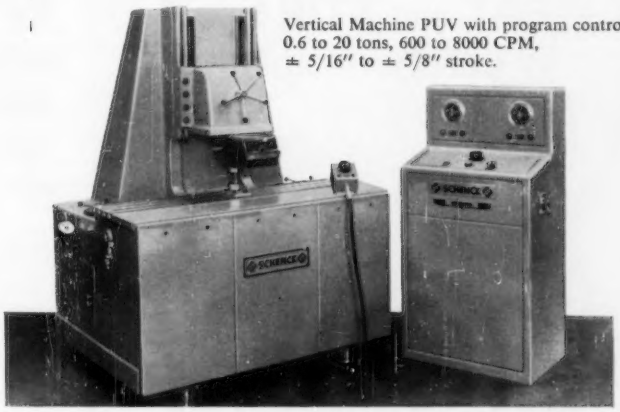

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Bookshelf

(*Continued from page 55*)

on a valuable publication which is highly recommended to all who have interests in the field of ferrous metallurgy.

M. OHTANI

Quality Control

N. L. Enrick, The Industrial Press, 3rd Edition, 1959, 185 pp., $4.50.

THE AUTHOR has presented in the third edition substantially the same material as appeared in the second edition. There is one new section pertaining to the evaluation of variations. In this section methods are presented whereby any significant differences between over-all variation and within-machine variation can be determined. The explanation of this type of analysis is presented in simple terms and examples so that the reader will have a minimum of difficulty in applying the techniques.

The examples presented in the book are chosen from a number of fields such as textiles, chemicals, and metals. The explanation of the basic concepts of statistical quality control are presented in a simple straightforward manner which does not require an understanding of statistical theory. The book would be of value to quality control personnel, students, and teachers.

D. S. HAMBY

Creep of Engineering Materials

Iain Finnie and William R. Heller, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y., 1959, 341 pp., illus., $11.50.

THIS IS A timely book on a subject not adequately treated elsewhere, with emphasis on the mechanics of creep and design rather than physical metallurgy, properties of specific materials, and test methods. The authors attempt to present the current state of knowledge of creep and design for conditions where creep is expected. They have succeeded very well in treating this complex and rapidly expanding subject in a readable and well-organized fashion. As is natural for a book on a rapidly developing topic, the volume is not entirely up to date. The references are abundant (but by no means exhaustive) and generally well chosen. The few critical evaluations of contemporary work which are included are not always the most discerning. One might wish the authors had made a more complete use of the references by stating the source of all the important observations and opinions—especially those presented in brief.

The topics covered include: One-third on mechanisms of creep of metals, plastics, and other nonmetals, and creep behavior of specific metals; one-third on stress analysis and theories of flow for uniaxial and multiaxial stresses under steady-state and transient creep, with applications such as thick-walled tubes, rotating disks, and buckling; and one-third on presentation of data, choice of design stress, and applications in such fields as chemical plants, steam, gas turbine and nuclear power plants, concrete, and geology.

The discussion of test methods and techniques is rather brief and there are very few creep curves of actual materials illustrated.

The sections on stress analysis are well presented, although the reader who lacks a substantial background in this area may need to consult the references for details. The presentation of viscoelastic theory and the superposition principle are somewhat sketchy. The available data supporting the usual assumptions employed for theories of creep under combined stresses are neither shown nor cited as references.

WILLIAM N. FINDLEY

High-Temperature Effects in Aircraft Structures

Edited by N. J. Hoff, Pergamon Press, Inc., New York, N. Y., 1958, 357 pp., illus., $12.

IN THE INTRODUCTION to this volume, editor Hoff states that aerodynamic heating has given the structural analyst of airframes two new parameters, namely, temperature and time, for his calculations. Using this as a theme, the editor has organized the writings of 16 authors into an extensive

(*Continued on page 59*)

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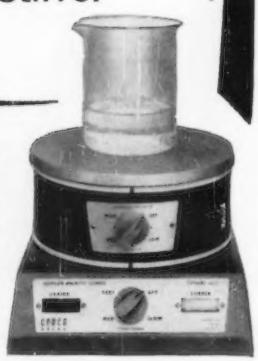

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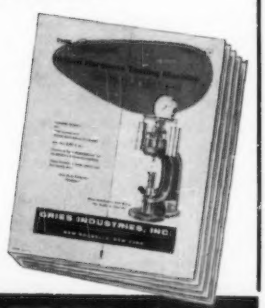

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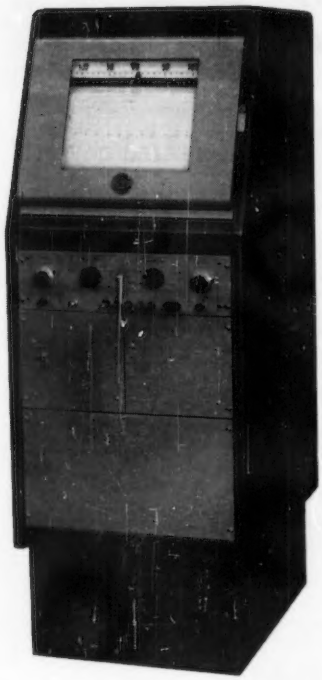
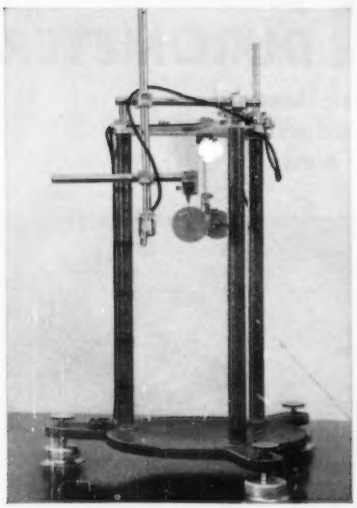


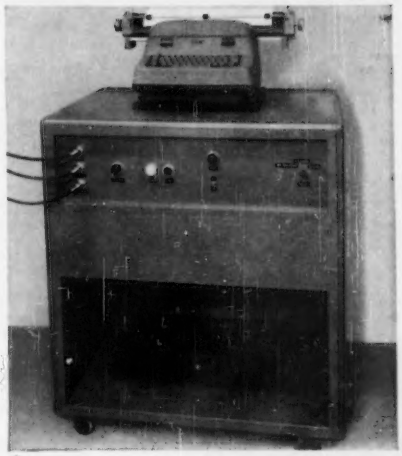
Dynamic load recorder makes a permanent record of fatigue tests and stress history of vibrating structures. It also provides a check on both operator and machine, thereby reducing the possibility of errors. Especially valuable for longer tests where a recording oscillograph would require an impractical quantity of recording paper. In zero to 12 cpm range, it plots the complete load cycle with one pen; in the 500 to 4000 cpm range, dual pens plot the upper and lower peaks of the applied dynamic load. Chart speeds: 1, 6 and 12 in. per hour. For more information, send for Product Data 4286.

Torsion Pendulum. Determine torsion modulus and damping characteristics of plastic materials with this precision torsion pendulum. Calibration curves are furnished for the percent crystallinity and density of Teflon* as a function of torsion modulus determined by this device. It consists of a pair of calibrated torsion arms which are suspended from the specimen and made to oscillate by battery-operated electromagnets. Bubble on frame and shockmounted leveling screws permit precise adjustment of vertical axis. For more information, send for Product Data 4181.

*Du Pont registered trademark



Easy-to-operate axial stress fatigue machines (Models AH-5 and AH-20) are especially suited to the testing of bolts, other round threaded devices, fasteners, sheets and chains. Substantial allowable creep permits testing at elevated temperatures. Alternating and static forces are set directly in pounds. Operating controls and instruments are housed in a separate console. Available in two models: 5000 lb. maximum total force (tension or compression) with maximum alternating force of ±2000 lb.; 20,000 lb. maximum total force (tension or compression) with maximum alternating force of ±8000 lb. For more information, send for Product Data 4231.



Self-checking offset yield strength printer speeds production testing—automatically records offset yield strength, extension under load, or yield point, together with tensile strength. Use with any standard B-L-H testing machine. Offset yield indicator circuitry ignores local stress-strain curve irregularities at start of test; rejects data where curve does not have a linear portion adequate to determine slope or where an error exists in equipment setup or operation. Typewriter indexes and advances automatically. For more information, send for Product Data 4285.

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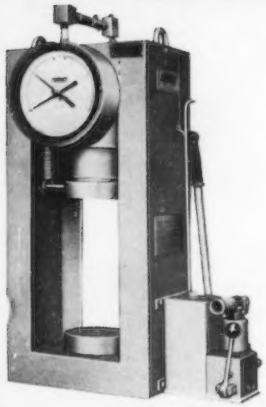

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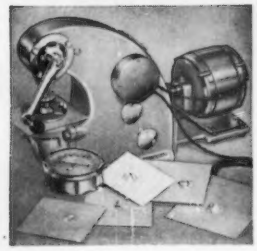

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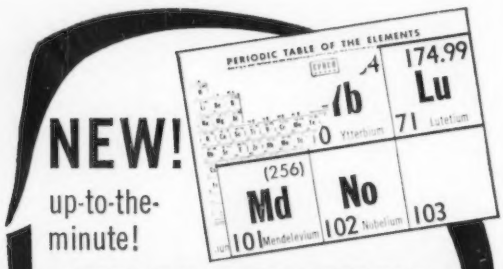

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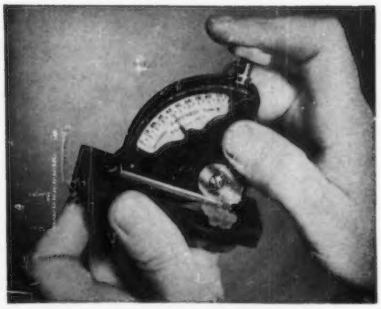

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CIRCLE 354 ON READER SERVICE CARD

Bookshelf

(*Continued from page 56*)

volume dealing with the subject of high-temperature effects in aircraft structures.

Essentially, the volume is divided into four parts. The first of these deals with the sources and transmission of heat in airframe structures. The second part of the volume deals with specific materials for airframe construction: metallic, nonmetallic, and glass-like materials. The third part covers the mechanical and physical properties of importance in airframe structures. The last part pertains to experimental methods for studying high-temperature effects.

To the reader who may be interested in a specific subject, the material in this book may be disappointingly general. For example, the chapter dealing with metallic materials is not specific and emphasizes titanium more than the precipitation-hardening stainless steels, which appear to be the major materials for construction of the faster airplanes, such as the B-58, the B-70, and the F-108. Further, very little mention is made about the materials problems existing in solid-propellant rocket-motor cases. However, here the omission is understandable because solid-propellant motor cases are a very special problem.

This book undoubtedly will be most useful to a structural analyst who has a working knowledge of the mathematical approach used by most of the authors in discussing their assigned subjects. Although a materials specialist may find that most of the discussions in this book are beyond his field of interest, he should find much useful information on materials other than those of his specialty and should gain an intuitive appreciation of the complicated problems facing a structures analyst when the two new parameters of time and temperature are introduced into structural problems.

J. J. HEGER

Hot Organic Coatings

Raymond B. Seymour; Reinhold Publishing Corp. (1959); 233 pp.; illus.; $7.50.

THE AUTHOR of this book covers a relatively neglected field in technical publications. Hot organic coatings have been receiving an ever-increasing use and acceptance, so that a broad look at this entire field is quite timely.

Because such a broad range of raw materials is involved, the details provided cannot be expected to make an expert out of an amateur. Nevertheless, the foundations are made available and should be useful to students, beginners, and experienced chemists.

Organization of the subject matter is logical, many interesting sample formulations are provided in every category, many pertinent specifications are quoted, numerous useful tables of chemical resistance are given, perform-

(*Continued on next page*)

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FOR FURTHER INFORMATION CIRCLE 355 ON READER SERVICE CARD

Bookshelf

(*Continued from page 59*)

ance characteristics are cited, and many application procedures are delineated. Helpful illustrations of applications are frequent.

RICHARD H. CUBBERLEY

The Structure of Metals

Institution of Metallurgists; Interscience Publishers, Inc. (1959); 118 pp.; illus.; $4.

THIS BOOK comprises four lectures on present theory of the structure of metals delivered at the Institution of Metallurgists' refresher course in 1958. The lectures, presumably printed verbatim, are all by well-known British metallurgists.

In the first paper, Professor Raynor summarizes, in 27 pages, the developments of the last 30 years in the electron theory of metals— a difficult task, nicely accomplished. He presents a coherent picture of the present generally accepted theory featuring the existence of allowed energy levels which contain vacant energy levels into which electrons can move and thereby determine certain physical properties of the metal or alloy.

The second lecture, by Dr. Catterall, concerns experimental aspects of the electron theory of metals. In a similarly compressed fashion, he shows how measurements of the electronic specific heat, magnetic susceptibility, electrical resistivity and associated transport properties, and soft X-ray emission spectra establish information on:

1. The width of the valence band,
2. The shape of the N(E) or "density of states" curves,
3. The shape of the Fermi surface,
4. The signs and numbers of the charge carriers in electrical conduction, and
5. The change of the above properties with alloying.

The last two papers concern dislocations in metals—theory and experimental confirmation.

Professor Quarrell reviews the developmental history of the dislocation theory of plastic deformation and discusses applications of the theory. His bibliography includes only four references, but these are the best known British, French, and American books on the subject.

The last paper, by Dr. Nutting, is on "Seeing Dislocations." He shows how the dislocation theory of plastic deformation has been experimentally verified in recent years through the development of techniques permitting dislocations to be observed directly. Twelve full-page halftone plates of photomicrographs and electron micrographs are included to represent the experimental proof of the existence of dislocations in metals. Unfortunately, these illustrations do not correspond in their caption plate numbers to the plate numbers referred to in the accompanying text. The reader must identify the proper plate by the credit references cited. This defect, and a few simple typographical errors, such as the misspelling of "plane" in two figures, could have been corrected by more careful editing prior to printing.

This book must be reviewed in the light of its stated purpose, a published record of refresher lectures given to members of the British Institution of Metallurgists. It will be useful in bringing metallurgists up to date in the areas covered and it may stimulate metallurgical students, as well as those interested in metallurgical technology, to read the original researches (cited in the book) on which the review lectures were based.

NORMAN A. NIELSEN

Abbreviated Annual Report of the Danish National Institute of Building Research, Report No. 11 (1957–58)

Danish National Institute of Building Research, Copenhagen K, Denmark; 65 pp. plus index.

THIS IS an interesting review of the activities of the Danish National Institute of Building Research. The function of the Institute is to coordinate, promote, and subsidize building research conducted either in other laboratories or planned by institutions and individual firms and to undertake independent investigations, often in collaboration with other laboratories.

(*Continued on page 62*)

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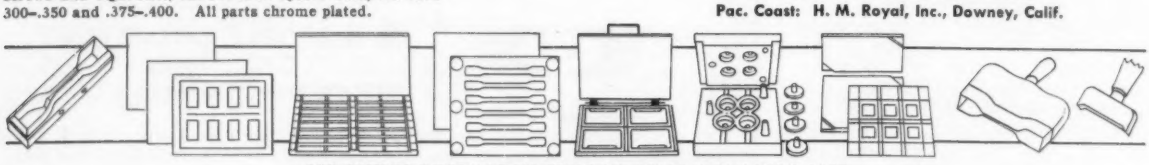

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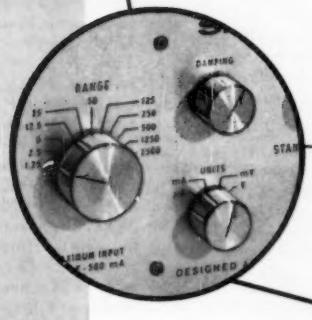

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Bookshelf

(*Continued from page 60*)

The report describes the status of the numerous projects covering many facets of building construction. Some of the subjects are: Construction and Design Economy, Building Materials and Constructions, Heating and Ventilating, Seasonal Adjustment of Employment, Foundations and Excavations, Type Selection and Standardization, Slum Clearance and Town Planning, and Farm Construction.

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OTS Research Reports

THESE REPORTS, recently made available to the public, can be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Order by number.

Tensile Properties of Aircraft Structural Metals at Various Rates of Loading after Rapid Heating: Part 1, PB 151566, $3.50.

Investigation of the Compressive, Bearing, and Shear Creep-Rupture Properties of Aircraft Structural Metals and Joints at Elevated Temperatures: Part 5, PB 151561, $2.

(*Continued on page 67*)

Other Societies' Events

November 2–4—**American Nuclear Society and Atomic Industrial Forum,** Annual Conferences, Sheraton Park Hotel, Washington, D. C.

November 2–5—**11th Exposition of the Air-Conditioning and Refrigeration Industry,** Convention Hall, Atlantic City, N. J.

November 2–5—**American Concrete Inst.,** 12th Regional Meeting, Continental Hilton and Hotel Del Prado, Mexico City, Mexico.

November 2–5—**Metallurgical Society of AIME,** Fall Meeting, Morrison Hotel, Chicago, Ill.

November 2–6—**American Society for Metals,** National Metal Congress and Exposition, International Amphitheatre, Chicago, Ill.

November 4–6—**Society of Rheology,** Lehigh University, Bethlehem, Pa.

November 4–6—**Society for Applied Spectroscopy,** Sectional Meeting and Instrument Exhibition, Hotel New Yorker, New York, N. Y.

November 4–7—**National Metal Trades Assn.,** 60th Annual Convention, Hotel Commodore, New York, N. Y.

November 8–13—**International Rubber Technology Conference, ASME, ACS, ASTM,** Shoreham Hotel, Washington, D. C.

November 9–11—**Steel Founders' Society of America,** Technical and Operating Conference, Carter Hotel, Cleveland, Ohio.

November 9–11—**American Petroleum Inst.,** 39th Annual Meeting, Conrad Hilton, Palmer House, and Congress Hotels, Chicago, Ill.

November 9–13—**National Electrical Manufacturers Assn.,** Annual Meeting, Traymore Hotel, Atlantic City, N. J.

November 11–13—**Pittsburgh Diffraction Conference,** Mellon Inst., Pittsburgh, Pa.

November 11–14—**Society of Naval Architects and Marine Engineers,** Annual Meeting, The Waldorf-Astoria, New York, N. Y.

November 16–18—**Packaging Inst.,** Annual National Packaging Forum, Statler Hotel, New York, N. Y.

November 16–19—**Building Research Inst.** Multisubject Conference, Shoreham Hotel, Washington, D. C.

November 24—**Manufacturing Chemists Assn.,** 9th Semiannual Midwinter Meeting, Statler Hotel, New York, N. Y.

November 29–December 4—**American Society of Mechanical Engineers,** Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

December 2–4—**The Metallurgical Society of AIME,** Electric Furnace Conference, Cleveland Hotel, Cleveland, Ohio.

December 6–9—**American Institute of Chemical Engineers,** Sheraton-Palace, San Francisco, Calif.

December 8–10—**2nd National Conference on the Application of Electrical Insulation, AIEE and NEMA,** Shoreham Hotel, Washington, D. C.

December 27–30—**American Statistical Assn.,** Shoreham Hotel, Washington, D. C.

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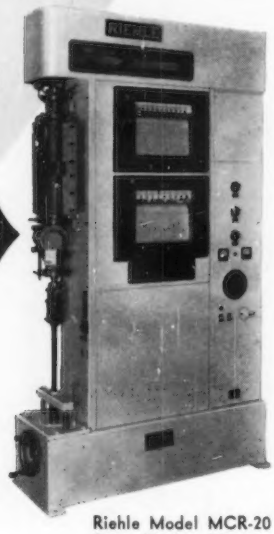

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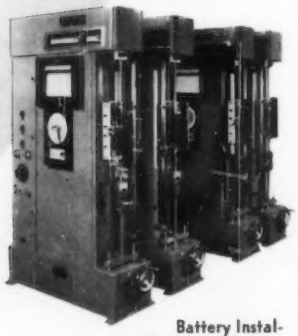

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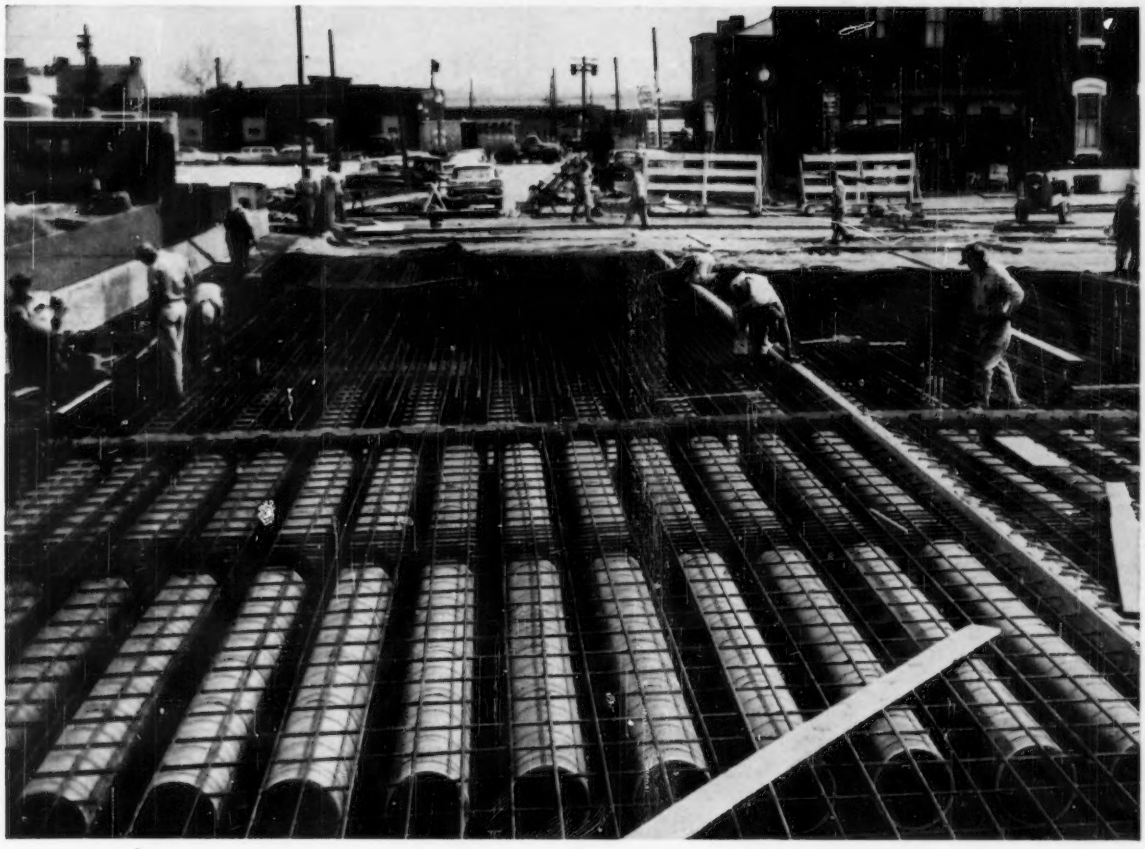

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NEW MEMBERS...

The following 71 members were elected from August 4 to September 9, 1959, making the total membership 9911 . . . Welcome to ASTM

Note—Names are arranged alphabetically—Company members first then individuals—
Your ASTM Year Book shows the areas covered by the respective Districts.

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Chicago District

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Andrews, Charles Lee, III, laboratory manager, Chicago Molded Products, Inc., 1020 N. Kolmar Ave., Chicago 51, Ill.

Drittier, O. E., supervisor, P. T. Laboratory, Reynolds Metals Co., First Ave. and 49th St., Brookfield, Ill.

Heller, Joseph, Gudeman Co., Chicago Div., 340 W. Huron St., Chicago 10, Ill.

Kistler, Chester E., head, Engineering Records Dept., Koontz-Wagner Electric Co., Inc., 343 Lincoln Way West, South Bend 1, Ind.

Mark, Clayton, III, director of research, Clayton Mark and Co., 1900 Dempster St., Evanston, Ill.

McKee, Keith E., research engineer, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill. For mail: 446 Wildwood Dr., Park Forest, Ill.

Stone, Harold C., chief metallurgist, Le Tourneau-Westinghouse Co., 2300 N. E. Adams St., Peoria, Ill.

Thompsen, Leo M., senior engineer, Morell & Nichols, Inc., 1905 Third Ave., S., Minneapolis 4, Minn.

* [A] denotes Associate Member.

Cleveland District

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Barrow, Gordon M., head, Chemistry Dept., Case Institute of Technology, 10900 Euclid Ave., Cleveland 6, Ohio.

Grossman, George W., Jr., president, Q-Panel Co., 14124 Lorain Ave., Cleveland 4, Ohio.

Hansen, F. Robert, assistant director of development, Ferro Chemical Corp., Division of Ferro Corp., Box 349, Bedford, Ohio.

Lutz, Allen F., metallurgist, MCL, Pratt & Whitney Aircraft Div., United Aircraft Corp., 400 Main St., East Hartford, Conn. For mail: 15009 Hilliard Rd., Lakewood 7, Ohio. [A]*

Mielke, Chester R., staff metallurgist, The Permold Co., Box 70, Medina, Ohio. For mail: 551 N. Broadway St., Medina, Ohio.

Detroit District

Jakeway, Charles E., research director, Grand Rapids Mills, Packaging Corporation of America, 415 E. Fulton St., Grand Rapids 3, Mich.

Settergren, Robert G., production coordinator, J. & G. Daverman Co., 924 Grandville Ave., S. W., Grand Rapids, Mich.

New England District

Bischoff, Frederick B., assistant professor, Lowell Technological Inst., One Textile Ave., Lowell, Mass. For mail: Box 223, 1 Currier Rd., Pelham, N. H.

Flook, Walter D., filament engineer, Champion Lamp Works, Division of Consolidated Electric Lamp Co., Lynn, Mass.

Kyle, Peter E., senior project engineer, Advanced Technology Group, Allied Research Associates, Inc., 43 Leon St., Boston 15, Mass. For mail: 24 Meriam St., Lexington 73, Mass.

Reid, Robert B., manager of engineering, Sylvania Electric Products, Estes St., Ipswich, Mass. For mail: 144 Colon St., Beverly, Mass.

New York District

Electro Tec Corp., Richard H. Loester, project engineer, 10 Romanelli Ave., S. Hackensack, N. J.

Brenner, Nathaniel, manager of applications engineering, The Perkin-Elmer Corp., Main Ave., Norwalk, Conn.

Brown, Elizabeth E., librarian, International Business Machines Corp., Research Library, Box 218, Yorktown Heights, N. Y.

Burns, William J., manager of mechanical engineering, Long Island Lighting Co., 175 Old Country Rd., Hicksville, N. Y.

Condon, Richard D., product specialist, The Perkin-Elmer Corp., Main Ave., Norwalk, Conn.

Murray, John J., Foundry Sales, 95 River St., Hoboken, N. J.

Northern California District

Davis, David K., metallurgist, Varian Associates, 611 Hansen Way, Palo Alto, Calif.

Malter, Louis, manager, Vacuum Products Div., Varian Associates, 611 Hansen Way, Palo Alto, Calif.

Ohio Valley District

Abner, John R., research engineer, Monsanto Chemical Co., 1515 Nicholas Rd., Dayton,

(*Continued on page 66*)

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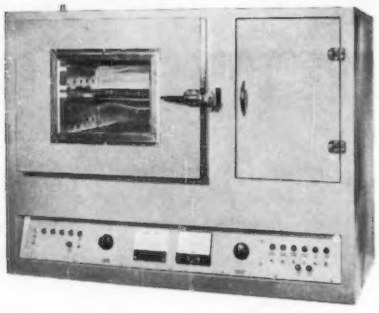
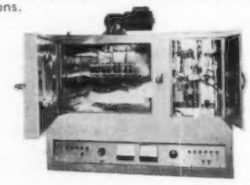
. . . certain factors associated with manual ozone measurement and control suggested the need for Automatically Controlled Ozone Test Chambers . . .



Orec 0300 Series employ an *electronic-chemical loop feed back servo system to achieve and precisely maintain chamber ozone concentrations.



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Compact design of Arcweld M-3 Creep Rupture Testers is emphasized here at nationally known research institute. Two rows, including eight Model L's (in rear), use only 338 square feet of floor space. Completely open fronts afford easy operation and loading, allowing machines to be set back-to-back.

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Arcweld Creep Rupture Testers Give Better Temperature Control

Ferrous alloys for new steel to be used in high temperature applications get their pedigree checked by one of the latest developments in the creep rupture tester field.

Specially designed to meet the needs of many creep laboratories which test smaller size specimens or use lighter loads, Model M-3 Creep Rupture Testers from Arcweld Manufacturing Co. are at work in a nationally known research institute under a U.S. Steel Corp. fellowship.

With the help of 30 M-3 and eight Model L Creep Rupture Testers, U.S. Steel plans to develop steels that will have the strength to withstand the stress, strain and elevated temperatures of powerful turbine engines, jet aircraft and missiles.

Richard R. Brady, who is in charge of U.S. Steel's giant Applied Research Laboratory at Monroeville, Pa., played an important part in the choice of Arcweld machines. According to Mr. Brady, Arcweld M-3's were chosen primarily for their design and trouble-free performance.

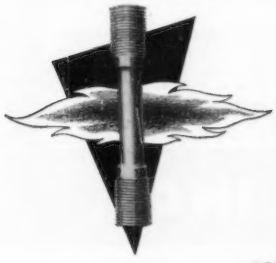
"These machines are very compact units," he explained. "Each one uses only four square feet of floor space, a very important point in conserving valuable working area."

Two rows of Arcweld machines, set back-to-back, use only 338 square feet of floor space. It is estimated that an equal number of competitive models would use twice as much space. Arcweld M-3 machines have completely open fronts which afford quick, easy loading up to 6,000 pounds. Their exclusive counterbalanced lever systems have a 16 to 1 ratio. The counterbalanced F-6 power positioning furnace produces up to 2,200 degrees Fahrenheit.

"One of the first Arcweld machines I used several years ago was the original Model M Creep Rupture Tester," said Mr. Brady. "I was very satisfied with its ability to perform tests. But now the new Model M-3 gives even better temperature control with precise accuracy.

"In addition to the trouble-free operation of the machines, Arcweld provides excellent service," he continued. "You get the service you want when you need it."

If you have an application for performance-proved, high temperature materials testing equipment, contact Arcweld soon. Complete engineering services are available to help solve your testing problems.



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New Members

(*Continued from page 64*)

Ohio. For mail: 913 Windsor Ave., Dayton 7, Ohio. [A]

McCullough, William L., Jr., technical engineer, Aircraft Nuclear Propulsion Dept., General Electric Co., Box 132, Cincinnati 15, Ohio.

Philadelphia District

Kennedy Van Saun Manufacturing and Engineering Corp., Florian Schwarzkopf, director of research and development, 63 Beaver St., Danville, Pa.

Bacon, John P., chief applications engineer, Elion Ultrasonics, Inc., 430 Buckle St., Bristol, Pa. For mail: 20 High Rd., Levittown, Pa.

Gruenstein, Doris K., textile technician, Industrial By-Products and Research Co., 2204 Walnut St., Philadelphia 3, Pa. For mail: 1001 E. Slocum St., Philadelphia 50, Pa. [A]

Katona, Charles Zoltan, chief of quality control laboratory, Columbian Carbon Co., 7345 Milnor St., Philadelphia 35, Pa.

Shoemaker, Edwyn L., Jr., quality control, Atlantic Prestressed Concrete Co., Box 886, Trenton, N. J.

Pittsburgh District

DeLuca, Noel S., managing director, Science House, Inc., 1294 Raven, Pittsburgh 16, Pa. For mail: Box 7913, Pittsburgh 16, Pa.

Miller, John William, chief carbide metallurgist, Carbide Div., Firth-Sterling, Inc., McKeesport, Pa.

St. Louis District

Balk, Kenneth, civil engineer, 222 N. Meramec, Clayton 5, Mo. [A]

Southeast District

Wilson, John C., senior engineer, Reliability Engineering, Electronic Communications, Inc., 1501 72nd St., N., St. Petersburg, Fla.

Southern California District

Costello, John L., owner, Costello Engineering Co., 6547 West Blvd., Inglewood, Calif.

Curwen, H. A., technical director, Earle M. Jorgensen Co., Box 2358, Terminal Annex, Los Angeles 54, Calif.

Grayson, C. D. R., chief chemist, Langley Corp., 310 Euclid, San Diego 12, Calif. For mail: Box 2911, San Diego 12, Calif. [A]

Jewett, J. Q., vice-president, Leeds, Hill & Jewett, Inc., 609 S. Grand Ave., Los Angeles 17, Calif.

Southwest District

Harris County Houston Ship Channel Navigation District, N. E. Hueni, chief engineer, Box 2562, Houston 2, Tex.

Haskell, N. B., chief supervisor, Product Control, Texaco Inc., Box 712, Port Arthur, Tex.

Service, W. J., partner, The Pace Co., 226 Winkler Dr., Houston 17, Tex.

Walker, Alice, research chemist, Visco Products Co., Box 87, Sugar Land, Tex. For mail: 7606 Meadowbriar Lane, Houston 27, Tex.

Whitsel, Travis S., Jr., laboratory manager, United Carbon, Inc., Box 791, Borger, Tex.

Washington (D. C.) District

National Acoustical Contractors Assn., K. B. Kleinsorge, executive secretary, 1632 K St., N. W., Washington 6, D. C.

Davis, Richard L., North Carolina manager, Emulsified Asphalt Refining Co., Box 5824, Raleigh, N. C.

Western New York–Ontario District

Bausch & Lomb Optical Co., Robert J. Meltzer, head, Measuring Instruments Dept., 635 St. Paul St., Rochester 2, N. Y.

Houghton Laboratories, Inc., Mark V. Goodyear, technical director, 322 Houghton Ave., Olean, N. Y.

Miller, Warren H., vice-president and technical director, Battenfeld Grease and Oil of New York, Box 144, North Tonawanda, N. Y.

Redman, Theodore H., staff engineer, Rochester Products Div., General Motors Corp., 1000 Lexington Ave., Rochester 3, N. Y.

Outside Established Districts

Milligan, Herbert L., design engineer, Packaging Development Group, Boeing Airplane Co., Seattle, Wash. For mail: 1812 155th Ave., S. E., Bellevue, Wash. [A]

U. S. Bureau of Reclamation, R. L. Sanderson, purchasing agent, Box 2553, Billings, Mont.

Other Than U. S. Possessions

Ponroca, Guillermo Ponte, engineer, Apartado 1745, Caracas, Venezuela.

Transvaal & O.F.S. Chamber of Mines, A. T. Milne, general manager, Box 809, Johannesburg, South Africa

Caplan, Maurice Cyril, chief works metallurgist, General Electric Co., Ltd., Fraser & Chalmers Engineering Works, Erith, Kent, England.

Chiaudano, Salvatore, general manager, Silo, Lungodora Savona, 48, Torino, Italy. For mail: Corso Stati Uniti 53, Torino, Italy.

Counsell, D. R., lubrication engineer, Irving Oil Co., Ltd., Saint John, N. B., Canada. [A]

Derqui, Fernando, main engineer and owner, Derqui Cimentos e Inyecciones, Tutor 46, Madrid, Spain. For mail: Santa Engracia 4, Madrid, Spain.

Henry, Pierre, consulting metallurgist, Compagnie des Forges de Chatillon Commentry et Neuves-Maisons, 19, rue de la Rochefoucauld, Paris (9eme), France. For mail: 16, rue Drouot, Paris (IXeme), France.

Mistry, Sheriar S., technical chemist, Ahura Chemical Products Provate, Ltd., 84, Sion Rd., Sion, Bombay 22, India. [A]

Morton, Daniel Salazar, soil mechanics, Laboratories de Ingenieria y Arquitectura,

(*Continued on next page*)

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New Members

(*Continued from preceding page*)

Presa Palmito 146, Col. Irrigacion, Mexico. D. F., Mexico. For mail: Goethe 44, Mexico 5, D. F., Mexico. [A]

Quinquini, Edifonso A., soils and asphalt engineer, Civil Aviation Assistance Group, United States Operations Mission to Afghanistan, International Cooperation Administration. For mail: c/o Morrison-Knudsen Afghanistan, Inc., Chaman, Pakistan. [A]

Thompson, Hugh Edward, fire research engineer, Canadian Wood Development Council, 27 Goulbourn Ave., Ottawa 2, Canada.

Weibull, Ivar Richard Walfrid, head of materials laboratory, Saab Aircraft Co., Linkoping, Sweden.

OTS Research Reports

(*Continued from page 62*)

An Improved Device for the Formation of Superfine, Thermoplastic Fibers, PB 151412, 50 cents.

The Synthesis of New Inorganic Molecules, Triphenylphosphonium Acid Chlorides, PB 151181, 75 cents.

A Method for Determining the Epoxy Content of Cured and Uncured Resins, PB 151150, 50 cents.

The Cushion Factor–Stress Curve and Its Value for Classifying and Selecting Package Cushioning Materials, PB 151547, $1.50.

Evaluation of Gas Transmission Rates of Flexible Packaging Materials, PB 151124, $2.75.

Glass, 1930–58, *Research on Glass and Glass Products,* CTR-370, 10 cents.

Fiber Glass and Glass Laminates, 1930–58, CTR-292, 10 cents.

Zirconia: Its Crystallographic Polymorphy and High Temperature Potentials, PB 151665, 75 cents.

Metal-Ceramic Laminates, PB 151664, $2.

Metal Fiber Reinforced Ceramics, PB 151610, $1.25.

Computers, 1937–58, A New Catalog of Technical Reports, CR-371, 10 cents.

Theory and Operation of a Dynamic Tester for Evaluating Package Cushioning Material, PB 121692 and its supplement, PB 121692S, $1.25.

Investigation of Design Criteria for Cushioning Materials, PB 151720, $1.

Development of Foamed-in-Place Plastic Energy-Absorbing Materials, PB 151436, $2.

High Density Foam-in-Place Edge Band for Prefabricated Panels, PB 151628, 50 cents.

Sixth Hot Laboratories and Equipment Conference, TID-7556, $1.75.

Mechanical Properties of AM350 and AM355 Stainless Steels, PB 151706, $1.50.

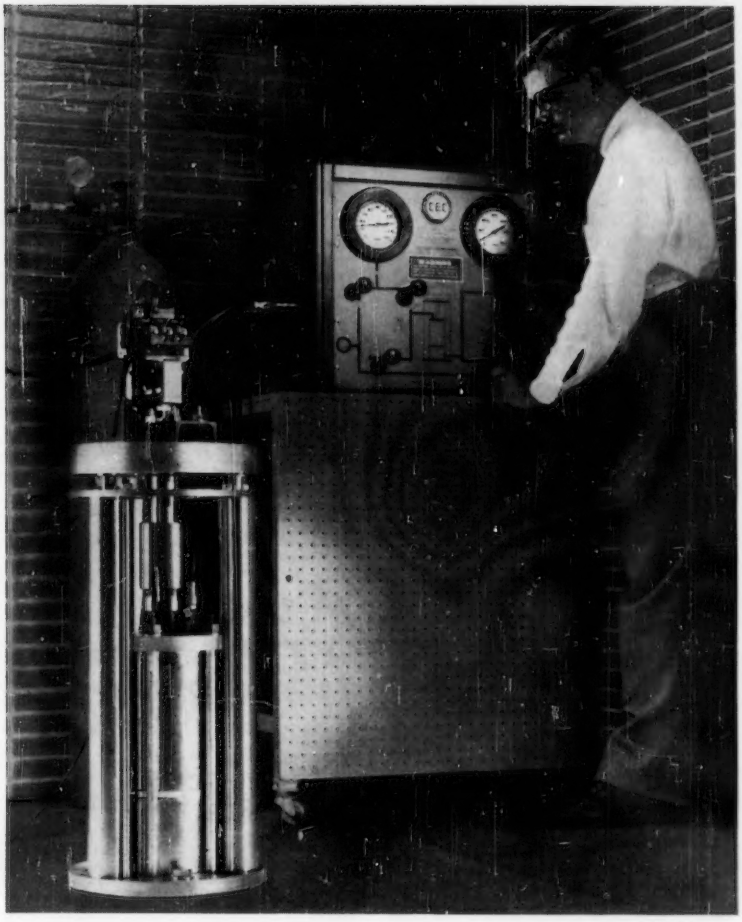
Development of New Mechanisms and Techniques for Obtaining Steels in the Ultra-High-Strength Range, PB 131238, $1.50.

Foundry Characteristics of Mn-V-Mo Age-Hardening Austenitic Steel, PB 151539, 50 cents.

Thermal Properties of Certain Metals: Part 2—Iron, Beryllium, Iridium, Palladium, Platinum, and Tungsten, PB 151679, $5.

An Investigation of the Mechanical Properties of Cermets as Related to the Microstructure, PB 151722, $2.25.

Development of Wrought Beryllium Alloys of Improved Properties: Part 1, PB 151711, $3.



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NEWS OF MEMBERS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co., Kingsport, Tenn., announced three new appointments in the Tenite Plastics Laboratories: **Ben P. Rouse, Jr.,** has been appointed chief chemist; **James G. Stranch, Jr.,** has been appointed senior chemist, in charge of the Plastics Laboratory; and **Thomas M. Hearst** has been appointed chemist, in charge of the Physical Testing Section of the Plastics Laboratory.

At the National Bureau of Standards, Washington, D. C.—**Paul T. Howard,** Chemistry Div., has been awarded the U.S. Dept. of Commerce Silver Medal for Meritorious Service. Mr. Howard was cited for "highly meritorious work on the development of specifications for organic coatings and for establishing an effective paint reference sample program." **Lafayette K. Irwin** has been appointed chief of the Engineering Mechanics Section. Formerly he was mechanical engineer. **Archibald T. McPherson,** associate director, has been awarded the U. S. Dept. of Commerce Gold Medal for Exceptional Service, in recognition of his work in improving the effectiveness of standardization activities of the Bureau, and of his major contributions to the development of young scientists and engineers. **Bruce L. Wilson,** previously chief, Engineering Mechanics Section, has been appointed chief, Mechanics Div.

Jane R. Andre, Columbus, Ohio, a prize-award student member of the Society, is the first woman in the United States ever to receive a bachelor's degree in welding engineering. Mrs. Andre was graduated from Ohio State University in June, and plans to work toward a master's degree and a Ph.D. in engineering.

Clifford E. Berry, formerly assistant director of research, Consolidated Electrodynamics Corp., Pasadena, Calif., has been appointed director of engineering for the company's Analytical and Control Instrument Div.

Lars E. Birbach is now research engineer, metallurgist, The Malden Research and Development Co., Inc., Malden, Mass. Formerly, he was president, Atlantic Chemical Co., Malden, Mass.

Johan A. Bjorksten, president, Bjorksten Research Laboratories, Madison, Wis., received the 1959 Honor Scroll of the Chicago chapter, American Institute of Chemists.

Byron F. Campbell, previously director of engineering, Clinton Machine Co., Clinton, Mich., is now executive engineer, Ingersoll-Kalamazoo Div., Borg-Warner Corp., Kalamazoo, Mich.

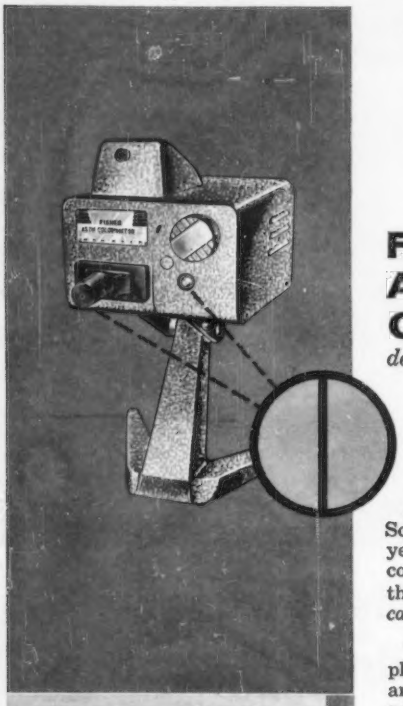
A. Edward Campi is now vice-president in charge of manufacturing, Royalon, of the Royal China Co. Previously he was plant manager, International Molded Plastics, Inc., Cleveland, Ohio.

Francisco Chairez resigned his position as chief chemist, Eastern States Petroleum and Chemical Corp., Houston, Tex., and has moved to Mexico City, Mexico, where he is in charge of Nalco de Mexico, S. A. de C. V. operations for Mexico. Mr. Chairez was very active in the ASTM Southwest District Council, having been secretary from 1955 until his move to Mexico. He also served as secretary of the Houston Engineers Council.

Nicholas Chryssafapoulos is now with Woodward-Clyde-Sherard and Associates, Greer Engineering Div., Montclair, N. J. Formerly he was assistant professor of civil engineering, University of Illinois, Urbana, Ill.

Maurice D. Cooper has been appointed head of the Chemistry Department at General Motors Research Laboratories, Detroit, Mich.

(*Continued on page 70*)



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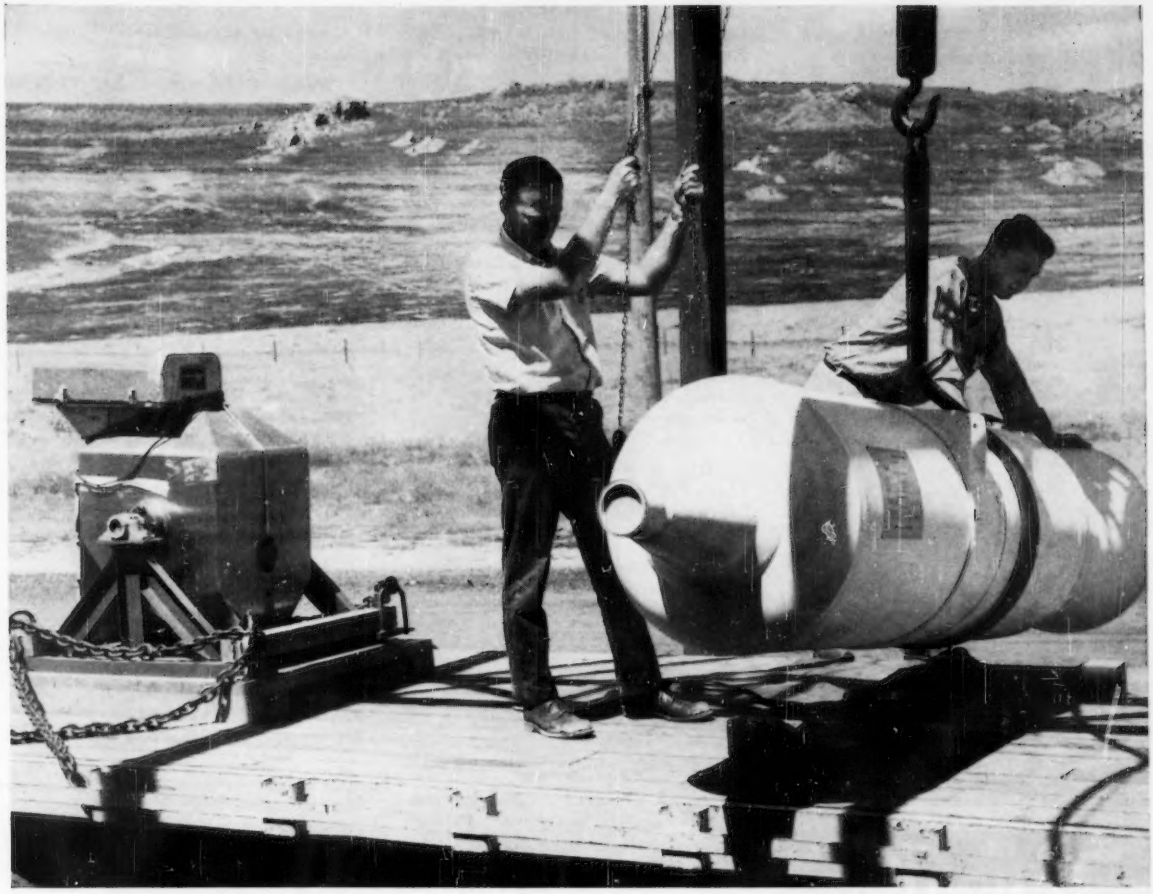

COBALT 60 AND THE MATADOR

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FOR FURTHER INFORMATION CIRCLE 365 ON READER SERVICE CARD

New Members

(*Continued from page 68*)

Roger Diaz de Cossio is now research associate professor, Institute of Engineering, University of Mexico, Mexico 18, D.F. Formerly he was research associate in civil engineering, University of Illinois, Urbana, Ill.

L. J. Demer, staff scientist, Rias, Inc., Baltimore, Md., is now in the Department of Metallurgical Engineering, University of Arizona, College of Mines, Tucson, Ariz.

Buell B. Dutton, until recently superintendent, Building Div., Village of Brookfield, Ill., is now director of building and zoning, Village of Skokie, Ill.

Roy E. Ellerhoff, formerly city engineer, City of Burlington, Iowa, is now civil engineer, Illinois State Highway Commission, Dixon, Ill.

Jack Fisher is the new managing director of the Metal Lath Manufacturers Assn., Cleveland, Ohio. He succeeds Donald R. Wadle in that position, and also in representing the Association's membership in ASTM.

Philip G. Fleming is now with the University of California, Lawrence Radiation Laboratory, Chemistry Div., Process and Materials Development, Livermore, Calif. Formerly he was an engineer with Bendix Aviation Corp., Kansas City, Mo.

Walter A. Gammel, Sr., previously project engineer, R-B-M Div., Essex Wire Corp., Logansport, Ind., is affiliated with Automatic Process Control, Union, N. J.

Michael P. Gaus, formerly research assistant, University of Illinois, Urbana, Ill., is assistant professor of engineering mechanics, The Pennsylvania State University, University Park, Pa.

George P. Hammond has accepted a position as field engineer, Torrington Construction Co., Inc., Gansevoort, N. Y. He had been construction engineer, U. S. Dept. of the Army, Corps of Engineers, Plattsburgh A.F.B., Plattsburgh, N.Y.

Henry H. Henenway was appointed director of research and engineering, Graver Tank & Mfg. Co., East Chicago, Ind., a division of Union Tank Car Co. Previously he was with Foster Wheeler Corp., New York, N. Y.

Harvey E. Henderson was named technical director, Lynchburg Foundry Co., Lynchburg, Va. Formerly he was research metallurgist.

Raymond Itaya, formerly assistant structural engineer, Division of Architecture, Department of Public Works, State of California, Sacramento, Calif., is affiliated with T. Y. Lin and Associates, Van Nuys, Calif.

William T. Jarrett is associated with North American Aviation, Inc., Los Angeles Div., Los Angeles, Calif., as senior engineer, flight test. He had been with the Airframe and Equipment Branch, Structures and Design Elements Group, Civil Aeronautics Administration, Washington, D. C.

Warren C. Johnson, formerly soils engineer, Edwards & Kelcey, Bahgdad, Iraq, is now chief materials engineer, Capitol Engineering Corp., Saigon, Vietnam.

E. G. Kimmich recently retired from The Goodyear Tire and Rubber Co., Akron, Ohio. During his almost 30 years of membership on Committee D-11 on Rubber and Rubber-Like Materials, Mr. Kimmich actively participated in many phases of the work of that committee. For 15 years he was a member of the Cleveland District Council and during that time served a two-year term as vice-chairman.

Robert C. Koch has been promoted to assistant manager of the Chemistry Dept., Nuclear Science and Engineering Corp., Pittsburgh, Pa.

Albert J. Kraemer, staff advisor, Division of Petroleum, U. S. Bureau of Mines, Washington, D. C., retired September 30, 1959. Mr. Kraemer had been with the Bureau for 36 years and has been a member of the Society for 33 years. His ASTM activities include over 30 years of service on Committees D-2 on Petroleum Products and Lubricants and D-16 on Industrial Aromatic Hydrocarbons and Related Materials, and the Washington, D. C. District Council. Other technical committee activities included ASA Projects Z11 and K 19.

(*Continued on next page*)

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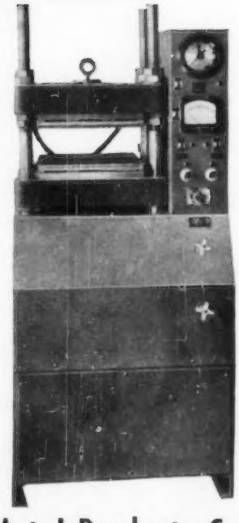

Wabash Metal Products Co.
1571 MORRIS ST., WABASH, INDIANA

CIRCLE 371 ON READER SERVICE CARD

News of Members

(*Continued from preceding page*)

Maxamillian A. Krimmel has joined the Harty Foundation, Savannah, Ga., as research associate.

Lauriston C. Marshall has accepted the position of associate technical director, Varo Mfg. Co., Inc., Garyland, Tex. Previously, he was director of research, Link-Belt Co., Research Laboratory, Indianapolis, Ind.

Frank M. Masters, consulting engineer, Modjeski and Masters, Harrisburg, Pa., has been given a stainless steel plaque by the Delaware River Port Authority in recognition of his efforts in connection with the construction of the Walt Whitman Bridge, which spans the Delaware River at Philadelphia.

Union Carbide Chemicals Co. has appointed **William H. Millett** an assistant director of the Technical Service Laboratory, and **E. Lacy Gibson** has been named administrative assistant to the director at the nearly completed laboratory, Tarrytown, N. Y.

Ralph L. Pitman, director of research, Rinshed-Mason Co., Detroit, Mich., has been promoted to technical director.

Mario Witold Polak is now affiliated with Guardian Engineering Co., Ltd., Calgary, Alta., Canada, as general manager. Formerly he was president and general manager, The Damar Systems, Ltd., Calgary, Alta., Canada.

B. K. Ramiah recently accepted a position in the Civil Engineering Dept., University of Mysore, College of Engineering, Bangalore, India. He had been a soils engineer for American Testing and Engineering Corp., Indianapolis, Ind.

R. B. Rohrer is now associate director, Research and Development center, Armstrong Cork Co., Lancaster, Pa. Dr. Rohrer, who represented the sustaining membership of the Armstrong Cork Co. in the Society, will be succeeded by Frank M. Gavan, manager of the Physical Test Dept.

L. H. Scheifele, engineer of tests, Reading Co., Reading, Pa., retired August 1, 1959. He was a long-time representative of his company's ASTM membership and served on technical committees since 1938. Mr. Scheifele represented his company on Committees A-2 on Wrought Iron; D-1 on Paint, Varnish, Lacquer, and Related Products; A-1 on Steel; and A-3 on Cast Iron.

Murray T. Stewart has joined The International Nickel Co. Research Laboratory, Bayonne, N. J. Previously he was with Canadian Steel Improvement Ltd., Toronto, Canada, as chief metallurgist.

John A. Succop, vice-president, metallurgy, Heppenstall Co., Pittsburgh, Pa., retired September 30, 1959, after 40 years of

(*Continued on page 72*)

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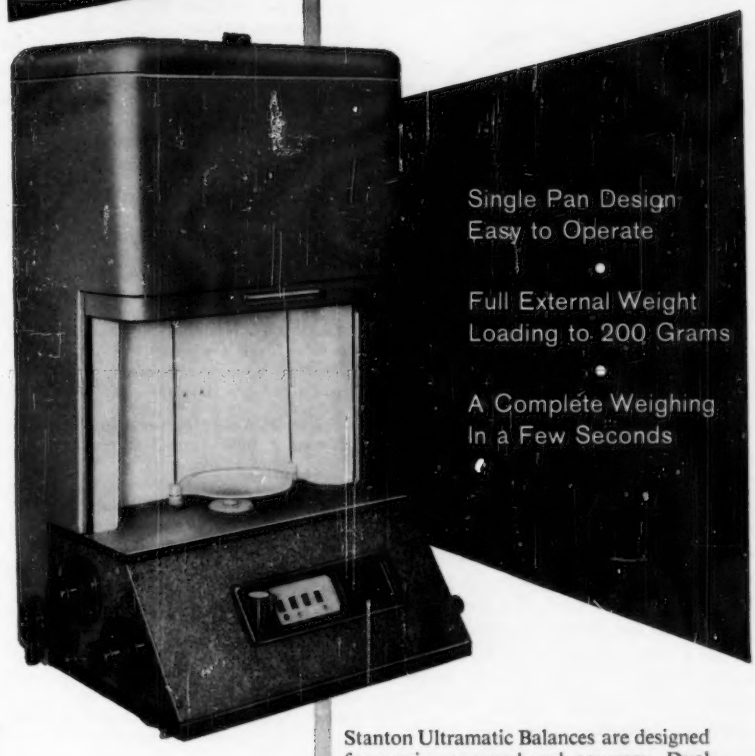

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KING

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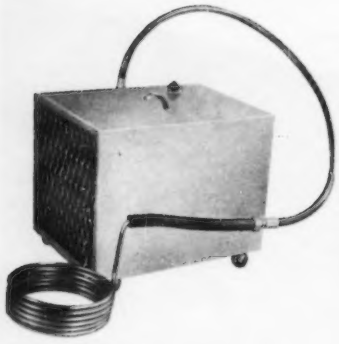

This Portable Liquid Cooler is on Casters so that it may be readily moved wherever desired. The coil can be immersed in glass jars, cans or other type containers. The control which is furnished with this Cooler can be set to operate from plus 75 to 25 F. at a differential of 3 degrees. To obtain lower temperatures or to use this Cooler as a unit for a constant temperature bath there is a switch which can be used to operate the unit continuously.

This Cooler will cool 5 gallons liquid from 120 to plus 30 F. in one hour.

The size of the cabinet including casters is: 12″ wide × 16″ long × 14″ high. The shell is painted a light sand finish. The Hermetic refrigeration unit is: 1/5 H.P., 110 volts, 60 cycle.

The flexible hose is 6 ft. long from the unit to the coil. The coil is nickel plated and is 8″ in diameter. The length of the flexible hose or coil diameter can be changed upon order.

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CIRCLE 368 ON READER SERVICE CARD

News of Members

(*Continued from preceding page*)

service with the company, and the same number of years as a representative of the Heppenstall Co. in ASTM. Mr. Succop also represented his company on Committees A-1 on Steel, E-7 on Nondestructive Testing, and the Gas Turbine Pan 1 of the Joint Committee on Effect of Temperature on Properties of Metals.

Charles L. Thomas has been appointed scientific adviser to Sun Oil Co., Marcus Hook, Pa. Formerly he was director, Research and Development Dept.

A. Carl Weber, director of research and sales engineering, Laclede Steel Co., St Louis, Mo., received the annual outstanding engineer award from the St. Louis Chapter, Missouri Society of Professional Engineer.

Charles B. Weiler is now the owner of the Glas Mesh Co., Westtown, Pa. Previously he was vice-president, insulation, Earl Paint Corp., Utica, N. Y.

Frank W. Yeager, a member of the Society since 1920, retired as chemical engineer, The Flintkote Co., Whippany, N. J. Mr. Yeager was very active in the work of Committee D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses, and for a time represented the committee in TAPPI.

DEATHS

Henry C. Ball, executive vice-president, Tufted Textile Manufacturers Assn., Dalton, Ga. (June 3, 1959). Mr. Ball represented TTMA in ASTM and also on Committee D-13 on Textile Materials.

Sherman R. Doner, technical representative, Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J. (August 12, 1959). Mr. Doner represented his company in Society membership and also on several technical committees. His committee activities included D-11 on Rubber and Rubber-Like Materials; D-24 on Carbon Black, of which he was chairman from 1956 to 1958; and E-1 on Methods of Testing. A member of the New York District Council since 1946, Mr. Doner was vice-chairman from 1952 to 1954 and chairman from 1954 to 1956.

Mariano J. M. Ferraz, managing director, Cia. Sorocabana de Material Ferroviario, Sao Paulo, Brazil (August 1959). Mr. Ferraz was an enthusiastic supporter of ASTM. In fact, he was an enthusiast in whatever he undertook. He was president of the Brazilian Standards Assn., president of the Brazilian Diabetic Assn., and was a loyal Rotarian, being past-president of the Sao Paulo group. He was a gracious host to vice-president Bates and the Executive Secretary when they spent several days in Sao Paulo in 1957, and he made a special trip from New York to Philadelphia to see the Executive Secretary in the hospital just a few weeks ago. He had a heart attack in May, but still persevered, and made his expected

(*Continued on page 75*)

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For wide variety of

liquids

9186-R2.

SPRAY BOTTLE, CHROMATOGRAPHIC (ATOMIZER), John (Patent pending). An ingenious spray tube provides uniformly fine mist or spray, as required for paper chromatography, from a wide variety of liquids with high or low viscosities, different vapor pressures, etc. Sprays large areas conveniently from a distance of approximately three feet when connected with a source of air pressure of three lbs. per square inch, but a pressure of five lbs. per square inch is recommended.

Instantaneous control of spray is provided by applying thumb to a 3/8-inch vent in rear of the spray tube. Spray tube is of Pyrex brand glass, with permanently attached plastic screw cap size No. 24 which fits commercial narrow mouth, screw neck bottles. Overall height 7½ inches; takes rubber tubing ¼-inch bore.

9186-R2. Spray Bottle, Chromatographic (Atomizer), John (Patent pending), as above described, with spray tube, screw cap and 8 oz. glass bottle, but without air pump or rubber tubing . . **8.00**

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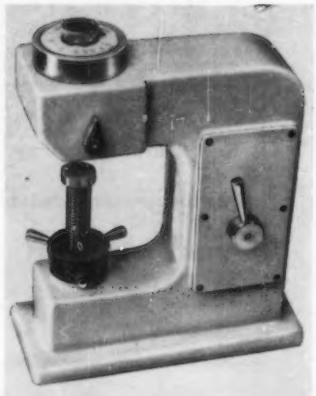

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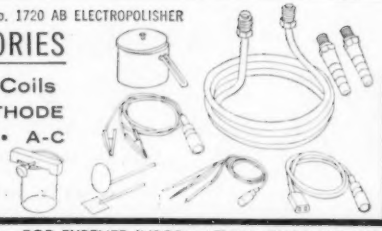

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CIRCLE 376 ON READER SERVICE CARD

Deaths

(*Continued from page 72*)

trip to the United States in July instead of earlier, when he had hoped to get to the ASTM meeting.

An engineer and executive of boundless energy, he typified the spirit which permeates Sao Paulo. To Mrs. Ferraz and their two sons is extended the sympathy of the Society.

J. O. Leech, Honorary Member of ASTM (September 9, 1959).

In the complicated work of every technical or professional Society, there will be found one or more individuals who, through their peculiar talents and dedication to certain phases of the work, have contributed immeasurably to the particular phase in which they were most concerned. Such a man in ASTM was J. O. Leech, long-time assistant metallurgical engineer, Carnegie-Illinois Steel Corp. Ollie Leech gave unstintingly of his time and knowledge to ensure that the rapidly growing number of ASTM steel specifications would be clearly and concisely written. Not only was this important to the specifications themselves, but, with others in the steel industry, he established a policy that is closely adhered to even now in the editing of all ASTM standards. This is not to say that Mr. Leech did not contribute much to the technical work, since he had a very practical working knowledge of steel production, but his most outstanding work had to do with making ASTM steel standards clear. His services to ASTM were recognized through election as a Director of the Society, the Steel Committee made him an Honorary Member, and he received the Society's highest award, the Honorary Membership.

Ill for many years, Mr. Leech made his home most recently in Schenectady, N. Y., with his wife and son, Bob, who is affiliated with the General Electric Co. In his death the Society loses one of its early pioneering members who contributed immeasurably to the advancement of ASTM activities, especially in the field of steel standards.

F. S. Mallette, executive secretary, Committee on Air Pollution Controls, The American Society of Mechanical Engineers, New York, N. Y. (Sept. 10, 1959). At one time Mr. Mallette was an individual member of the Society, but more recently he represented ASME on ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis, and also represented that committee on Committee E-8 on Nomenclature and Definitions.

Dalton G. Miller, retired materials engineer, Bureau of Public Roads, U. S. Department of Commerce, University of Minnesota, St. Paul, Minn. (June 26, 1959). Mr. Miller, a member of the Society since 1924, was very active in the work of Committees C-6 on Drain Tile; C-4 on Clay Pipe, of which he was chairman at the time of his death; C-1 on Cement; and C-15 on Manufactured Masonry Units. In recognition of his valuable contributions to this field, he was elected to Honorary Membership on Committees C-1 and C-15.

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CIRCLE 377 ON READER SERVICE CARD

NEWS NOTES ON
Laboratory Supplies and Testing Equipment

Note. This information is based on literature and statements from apparatus manufacturers and laboratory supply houses. The Society is not responsible for statements advanced in this publication.

Laboratory Items

pH Accessory—A new pH electrode adapter for use with the Cary vibrating reed electrometer has been announced, which facilitates precise measurements of pH changes as small as 0.0005 units.
Applied Physics Corp. 3215

Electronic Voltmeter—A new electronic voltmeter is now being offered. This new model 2409 measures either rms, peak, or average value of voltage over the frequency range from 2 to 200,000 cps.
B & K Instruments, Inc. 3216

Mercury Collector—To collect mercury, accidentally spilled, remove lid and foam pad from polyethylene container and press the lid with foam pad firmly against the surface on which the mercury has been spilled. The pressure applied will open up the cells in the pad so that the individual globules can enter the opened-up cells.
Bel-Art Products 3217

Jar Bath—Maximum utilization of working area (99.9 per cent) plus the patented design features of Blue M Magni-Whirl jar baths incorporating full visibility, complement their extreme versatility of operation. The unique method of agitation of these baths maintains constant uniformity by gentle and automatic pulsation.
Blue M Electric Co. 3218

Tester Measures Cleanliness—The new model CM-1 cleanliness tester makes it possible to assign numerical values to surface cleanliness where nonbonded soils are involved. The CM-1 will measure smut residue after pickling of steel. In addition, the tester may be used to evaluate detergents and oils used on cold mills, annealing furnace performance, and efficiency of electrolytic and alkaline cleaning lines.
Branson Ultrasonic Corp. 3219

Vacuum Gage—A new direct-reading gage for continuous measurement of gas pressure in a vacuum system has been developed. Called the Cenco thermocouple vacuum gage, the new instrument is sturdily built for industrial use, is self-regulating, and will measure total gas pressures in the range of 0.001 to 1 mm of mercury.
Central Scientific Co. 3220

Bending Clamp—CSI announces the availability of the bending clamp, transfer tool and specimen holders with the CSI nicking jig model CS-92, described in the ASTM "Proposed Method of Test for Environmental Stress Cracking of Ethylene Plastics" (Compilation of ASTM Standards on Plastics, September 1958, Appendix I).
Custom Scientific Instruments, Inc. 3221

Power Supply—A new rack-mounted, dual-range d-c power supply, designed for servicing and development of both transistor and tube circuits has been announced. Known as model EFBR power supply, the new unit has less than 10 mv ripple at top load, and is intended for operation from 117 v 60 cps supply source.
Electro Products Laboratories 3222

Static Meter—Model 250 is an electrometer voltmeter designed to measure static charge voltages easily and accurately. It features a sensitive detecting head and low-noise connecting cable. Full scale ranges are 10 and 30 kv when the detecting head is brought approximately $\frac{3}{8}$ in. from the charged surface. Up to 100 kv can be measured with the detecting head operated at a distance of 6 in.
Keithley Instruments, Inc. 3223

Filter—A new porous filtering crucible for the determination of graphitic carbon in cast iron is announced. Samples containing graphitic carbon are filtered directly into the new crucible and subsequently combusted in a high frequency furnace.
Laboratory Equipment Corp. 3224

Power Supply—The model 154 transistorized power supply features four regulated outputs in standard 19-in. relay rack unit. Three d-c outputs and one a-c output are provided for simultaneous operation: 200 v dc at 50 ma; 100 v dc at 50 ma; −50 v dc at 5 ma; and 6.3 v ac at 5 amp, all regulated within 0.25 per cent.
Mid-Eastern Electronics, Inc. 3225

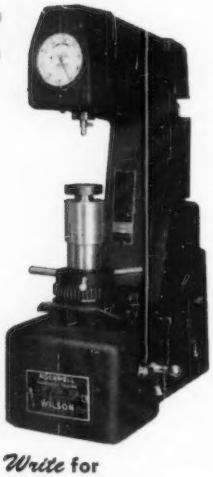
Insecticide Tester—A radiotracer method for precise measurement of insecticide diffusion and absorption in foodstuffs is available. The unique testing method saves valuable time by getting results in weeks instead of months.
Nuclear Science & Engineering Corp. 3226

X-Ray Spectrograph—The universal vacuum X-ray spectrograph, requiring no helium for elements in the atomic range No. 12 to 22, and achieving also higher intensities for elements 17 to 30, has been announced.
Phillips Electronics, Inc., Instruments Div. 3227

Concrete Tests—Rainhart Co. claims that more rapid, economical, and accurate tests can be performed in accordance with current ASTM C 78, AASHO T-97, or U. S. Army CRD-C16 specifications by using the new 78C16 recording charts in any of their portable 415UL beam breakers. They emphasize that the modulus of rupture to within 2 psi can be read

(*Continued on next page*)

One of these Wilson "Rockwell" instruments will do your hardness testing job



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Laboratory Items

(*Continued from preceding page*)

directly from the automatic load recording for most specimens and can be determined more easily and quickly for all others.
Rainhart Co. 3228

Scales—Remote indication of both batch and cumulative weights is given in a compact new unit recently introduced. The new unit combines indicator and single unit totalizer.
Richardson Scale Co. 3229

Torquemeter—A versatile torquemeter provides linear deflection to any full-scale torque desired within the range 50 to 100 per cent of the sensor maximum torque. This feature permits smaller torque increments to be observed and considerably improved accuracy to be obtained when measuring less than sensor maximum torque.
Rotiform Co. 3230

Thermometer—A new red-reading mercury industrial thermometer is now being produced. Rugged, accurate, and quick-responding, the new Tag industrial thermometer offers 15 features of special engineering interest to the user, including an exclusive dust-proof, rattle-proof glass and cover.
Tagliabue Mfg. Co. 3231

Water Analysis—Silica concentration in demineralizer make-up water can now be analyzed automatically by using the new AutoAnalyzer. A valuable aid to power plant instrumentation, the Technicon AutoAnalyzer measures concentration of trace materials down to parts per billion.
Technicon Controls, Inc. 3232

Sweep Generators—Sweep rates as low as 0.01 cps are possible with a new line of variable-rate sweep and marker generators now being produced. The new instruments, models LR 3, LR 4, LR 5, and LR 6, cover the frequency range from 3.5 to 140 Mc.
Telonic Industries, Inc. 3233

Plastimeter—The new Wallace rapid plastimeter makes a plasticity test in less than one minute and no cleaning is necessary between tests. It uses the modified parallel plate compression principle. A compressive force is applied to the specimen immediately after a "conditioning" period of 10 sec, during which the specimen is brought to a uniform temperature and thickness.
Testing Machines, Inc. 3234

Contour Measuring—New model SP-2 Counter-O-Scope for fast economical checking of contour parts up to 30 in. in diameter and 10 in. wide has been announced.
TurboTronics Corp. 3235

Potentiometer Recorder—The new G-22 is a compact, low-cost, dual-channel strip chart recorder with both pens traversing the full width of a 5-in. chart. Weight is only 35 lb. Portable and panel-mount versions are available. Interchangeable plug-in input chassis on each channel permit various recording characteristics to be used. Range is adjustable from 0 to 9 mv to 0 to 100 mv. Zero can be set anywhere across the chart.
Varian Associates, Instrument Div. 3236

Vacuum Gage—A new combination discharge gage and two-station thermocouple gage control, for measuring pressures between 1000 microns and 5×10^{-6} mm of mercury, is now available. Designated the DG 2-2T, the vacuum gage combines two separate gages in one compact cabinet.
Veeco Vacuum Corp. 3237

Vacuum Pump—To meet the need for an easy method of sampling where contamination must be avoided and where highly corrosive liquids are involved, a vacuum pump known as the "Golden Thief" has been developed.
W & W Mfg. Co. 3238

Catalogs & Literature

Radiation Sources—A new 12-page brochure has been published detailing capabilities to provide radiation sources for irradiation research, radiography, and teletherapy.
Nuclear Systems Div., The Budd Co. 6129

Reagents—From A to Z, the new 1959 Fisher Chemical Index, *Catalog No. 123*, describes 7000-plus chemicals in one easy-to-use alphabetical listing.
Fisher Scientific Co. 6130

Laboratory Ware—The new 24-page *Catalog No. H-459*, covering polyethylene, polypropylene, polyurethane, and polyvinyl plastic laboratory apparatus is now available.
General Scientific Equipment Co. 6131

Air Testing Instruments—Data sheets describe full line of air testing instruments, thermometers, psychrometers, humidity dials, air samplers, dust counters, etc.
E. Vernon Hill & Co., Air Instruments 6132

Nuclear Density Gage—New 2-page *Bulletin SG* describes the method of operation and performance advantages of the Ohmart nuclear density gage used for continuous, noncontact measurement and control of per cent solids in a slurry, specific gravity of a liquid, and detection of interface position in pipelines.
The Ohmart Corp. 6133

Weight Scales—*Bulletin 321-BW*, describing the Wall basis weight scale, is available. In addition to a comprehensive outline of the uses and features of the Wall basis weight scale, this bulletin describes in detail the exclusive multirange instrument dial.
Thwing-Albert Instrument Co. 6134

Plastic Ware—A colorful 24-page catalog, featuring a complete line of disposable culture dishes, tubes and flasks, as well as a wide range of unbreakable, lifetime plastic ware, has been issued. The new brochure lists a rich assortment of benchware for every job.
Will Corp. 6135

News of Laboratories

Industrial and Biological Research Institute, Ltd., Cologne, Germany—The Industrial and Biological Research Institute in Cologne is moving in the near future into new enlarged premises by the Rhine (Oberländer Ufer 118). The Institute has special divisions for Chemistry of Nutrition, Experimental Medicine and Pharmacology, Animal Feeding Stuffs and Feed Supplements, and also Detergents and Soaps. The work of the Institute covers all fields in any way involving living matter or its products.

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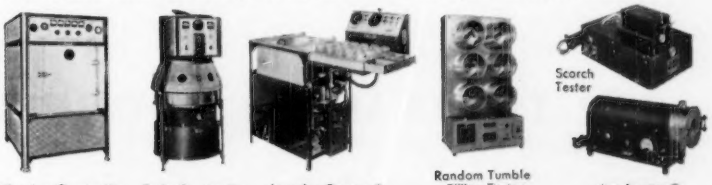
Weather testing translucent fiberglas for outdoor use in an Atlas Weather-Ometer at the Alsynite Company of America.



Weather-Ometer® Fade-Ometer® Launder-Ometer® Random Tumble Pilling Tester Scorch Tester Accelerotor®

FOR FURTHER INFORMATION CIRCLE 379 ON READER SERVICE CARD

Federal Government Standards Index Changes

THE FEDERAL Supply Service of the General Services Administration is charged with the responsibility for establishing specifications to be used by the Federal Government for Procurement of materials and supplies. The GSA issues an annual Index of Initiation of Federal Specifications Projects, and monthly supplements.

The items listed below appeared in Supplement No. 5 for the month of July, 1959.

INITIATIONS

Title	Type of Action	Symbol or Number	FSC Class	Assigned Agency & Preparing Activity
Cloth, Cotton, Cheesecloth	Am. 1	CCC-C-440	8305	GSA-FSS
Plastic Sheet, Vinyl (for Wall Covering)	New	L-P-00522 (COM-NBS)	5430	COM-NBS
Spikes and Nails, Common Cut	Am. 1	FF-S-606	5315	DOD-USAF
Thread, Nylon	New	V-T-295	8310	DOD-Army-QMC
Tubing, Flexible, Aluminum Alloy	Am. 2	WW-T-816	4710	DOD-USAF
Wire, Brass	Rev.	QQ-W-321b	9525	DOD-Army-Ord
Wire and Rods, Aluminum and Aluminum Alloy, For Die Headings	New	....	9525	DOD-USAF

WITHDRAWALS

Title of Specification	Type of Action	Symbol or Number	Assigned Agency or Technical Committee	Reason for Withdrawal
Steel Bars, Carbon, Hot Rolled (Mechanical Properties)	New	...	DOD-Army-Ord	Items covered by other specifications

PROMULGATIONS

Title	Type of Action	Symbol or Number
Continuous Identification Marking of Iron and Steel Products	New	Fed. Std. No. 183
Labels, Paper Gummed	Rev.	Fed. Std. No. 108c
Copper-Silicon Alloy, Rod, Wire, Shapes, and Flat Products (Flat Wire, Strip, Sheet, Bar and Plate) (superseding QQ-C-591a)	Rev.	QQ-C-591b
Crates, Wood, Household Goods	Am. 1	PPP-C-580
Drier, Paint, Liquid	Am. 1	TT-P-651c
Pigment, Sienna, Raw and Burnt, Dry (superseding TT-S-00346a (GSA-FSS) & TT-S-346)	New	TT-P-435
Tag and Holder, Key	Am. 1	FF-T--77
Tape, Gummed, Mending and Reinforcing, (Paper and Cloth) (superseding UU-T-101d (GSA-FSS) & UU-T-101c)	Rev.	UU-T-101e
Tongs, Sterile Fluid Storage Bottle	New	GG-T-560
Waste Receptacle, Step-On Type (superseding RR-C-121)	New	RR-W-75
Wringer, Mop (superseding RR-W-00670b (GSA-FSS) & RR-M-571 (in part))	New	RR-W-670

INTERIM FEDERAL SPECIFICATIONS ISSUED

Title of Specification	Type of Action	Symbol or Number
Cements, Hydraulic, Sampling, Inspection and Testing	Am. Chg. Not. 1	Fed. Test Method Std. 158 (COM-NBS)
Anti-Seize Compound, White Lead Base, General Purpose (for Threaded Fittings)	New	TT-A-00580 (GSA-FSS)
Dishwashing Compound, Machine, Containing Stain Remover, Chlorine-Releasing Type	New	P-D-00435 (GSA-FSS)
Funnels, Filtering, Glass, Buchner Type	New	DD-F-00776b (GSA-FSS)
Methanol, Technical (Methyl Alcohol)	New	O-M-00232c (Army-CE)
Napkins, Table, Paper	New	UU-N-00106d (GSA-FSS)
Paint, Ready-Mixed, Outside, Medium-Chrome-Yellow	New	TT-P-0053b (Army-CE)
Plastic Sheet, Laminated, Decorative, and Non-decorative	Rev.	L-P-00508b (GSA-FSS)
Polish, Metal	New	P-P-00556b (GSA-FSS)
Tape, Textile, Cotton, General Purpose (Gray, Bleached or Dyed)	New	DDD-T-0086a (GSA-FSS)

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The Vicatester, a Plastisol Cure Tester fills the need for an easily applied instrumental method of evaluating the penetration hardness and resiliencies of polymeric materials, providing readings that can be directly translated into terms which describe the penetration hardness and natural resiliency of the particular material being tested.

The Vicatester measures the degree of elastic recovery exhibited when the driving load is removed from the penetration needle. Available adjustments permit testing samples of varying initial thicknesses and shapes, giving chart readings for needle motion as slight as 0.7 mils, or as much as 125 mils.

Bulletin M-5914 is available giving more complete information.

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FOR FURTHER INFORMATION CIRCLE 380 ON READER SERVICE CARD

INDEX TO ADVERTISERS

ARCWELD MANUFACTURING CO. 65
ATLAS ELECTRIC DEVICES CO. 77

B & H INSTRUMENT CO., INC. 59
BALDWIN-LIMA-HAMILTON CORP. 57
BRANSON INSTRUMENTS, INC. 5
BUDD NUCLEAR SYSTEMS
A DIVISION OF THE BUDD CO. 69
BUEHLER LTD. 74
BURRELL CORP. 71

CADY & CO., E. J. 58
CENTRAL SCIENTIFIC CO. 54, 56, 58
CONSOLIDATED VACUUM CORP. 67
COSA CORP. 55

DELTA CHEMICAL WORKS, INC. 74

EASTMAN KODAK CO. 51
EBERBACH CORP. 54

FISHER SCIENTIFIC CO. 68
FORNEY'S INC., TESTER DIVISION 58

GENERAL RADIO CO. . . . . Inside Back Cover
GILSON SCREEN CO. 79
GRIES INDUSTRIES, INC. 56

HIRSCHMANN CO., INC., CARL 4
HOGGSON & PETTIS MFG. CO. 60

INSTRON ENGINEERING CORP. . . . . Inside Front Cover
INSTRUMENTS FOR RESEARCH AND INDUSTRY . . . 75

KING REFRIGERATION CO. 72
KLETT MFG. CO. 54

LACLEDE STEEL CO. 63

NEWAGE INDUSTRIES, INC. 74

OLSEN TESTING MACHINE CO., TINIUS . Outside Back Cover
OZONE RESEARCH AND EQUIPMENT CORP. 64

PICKER X-RAY CORP. 3

RIEHLE TESTING MACHINES
A DIVISION OF AMERICAN MACHINE AND METALS, INC. 62

SARGENT & CO., E. H. 61
SCOTT TESTERS, INC. 2
SHORE INSTRUMENT & MFG. CO., INC. 58
SIEBURG INDUSTRIES INC. 70
SMS INSTRUMENT CO. 54
SOILTEST, INC. 72
SYNTRON CO. 52

TATNALL MEASURING SYSTEMS
A SUBSIDIARY OF THE BUDD CO. 53
TESTING MACHINES, INC. 66
THOMAS CO., ARTHUR H. 73
THWING-ALBERT INSTRUMENT CO. 78

UNITRON INSTRUMENT DIVISION OF UNITED SCIENTIFIC CO. 80

WABASH METAL PRODUCTS CO. 70
WILSON MECHANICAL INSTRUMENT DIVISION
AMERICAN CHAIN & CABLE CO. 76

ZEISS, CARL, INC. 73

PROFESSIONAL CARDS 48, 49, 50

CANCELLATIONS

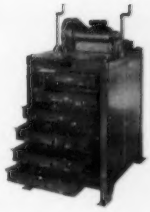
Title	Symbol or Number	Reason for Cancellation
Continuous identification marking of nickel and nickel base alloys	Int. Fed. Std. 00137	Superseded by Fed. Std. No. 182
Steel, Tool, Alloy	QQ-S-00778 (Army-Ord)	Superseded by Fed. Spec. QQ-T-570

SPECIFICATIONS AND STANDARDS APPROVED FOR PRINTING

Title of Specification	Type of Action	Symbol or Number
Identification Marking of Aluminum, Magnesium, & Titanium	New	Fed. Std. No. 184
Boxes, Fiberboard, Six or Eight Sides	New	PPP-B-655
Bunting, Cotton, Mercerized	Canc.	CCC-B-791a
Cloth, Cotton, Bunting, Mercerized	New	CCC-C-439a
Packing of Fiber Boxes, Liners, and Sleeves, Knocked-Down, Flat	New	PPP-P-10
Paint, Blue-Lead-Base, Basic-Sulfate, Linseed-Oil, Ready-Mixed	Am. 2	TT-P-20
Paper, Blotting	Rev.	UU-P-63c
Paper, Duplicating, Copy, Liquid Process	New	UU-P-232a
Paper, Ledger, Unruled	Rev.	UU-P-288d
Paper, Manifold	Rev.	UU-P-328e
Paper, Mimeograph	Rev.	UU-P-388h
Paulin, Fire, Water, Weather and Mildew-Resistant	Rev.	K-P-146b
Pine Tar, Technical	New	LLL-P-430a
Pipe, Cast-Iron, Pressure (Gas & Water)	New	WW-P-360a
Pipe-Fittings, Malleable Iron, Wrought Iron, and Steel (Screwed), 150-lb.	Rev.	WW-P-521d
Primer Surfacer, Sanding, Lacquer and Enamel Type	Am.	TT-P-662
Screening, Wire, Insect	Am. 2	RR-S-141a
Tape, Pressure-Sensitive Adhesive, Masking, Paper	Rev.	UU-T-101c
Tool Steel, Alloy	New	QQ-T-570

Test Aggregates Accurately, Conveniently with the

GILSON TESTING SCREEN



Sizes test samples of crushed stone, sand and gravel, slag, coal and coke, ores, and similar materials, in a size range from 4-in. to 200-mesh. Makes 2 to 7 separations simultaneously in 5-minutes or less. Sand attachment optional for use with 8-in. sieves. Also ideal for moderate-scale research mass-separation jobs.

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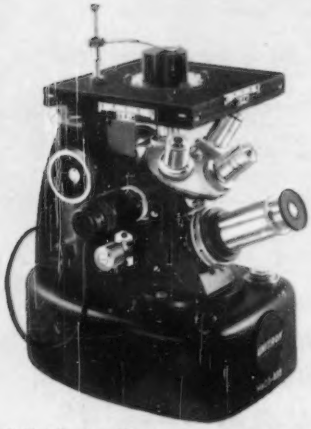

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★ Usable beat notes for measurements can be produced with 50-mv input signal.

★ Touch-button frequency deviator can be used to introduce a momentary frequency decrease for establishing "sense" in indications near zero beat.

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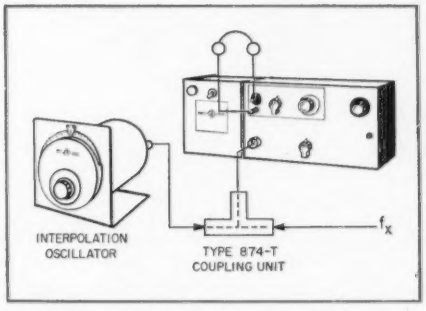

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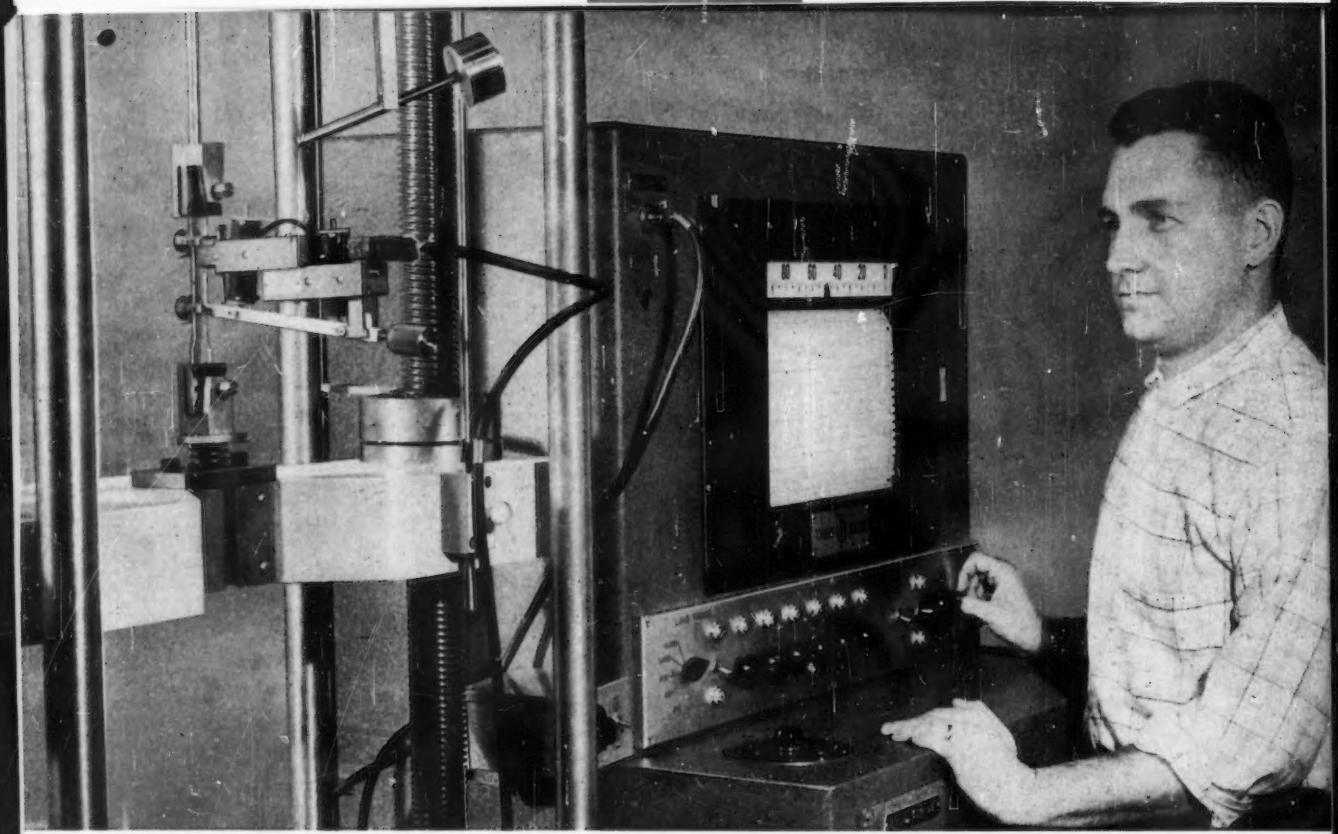

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